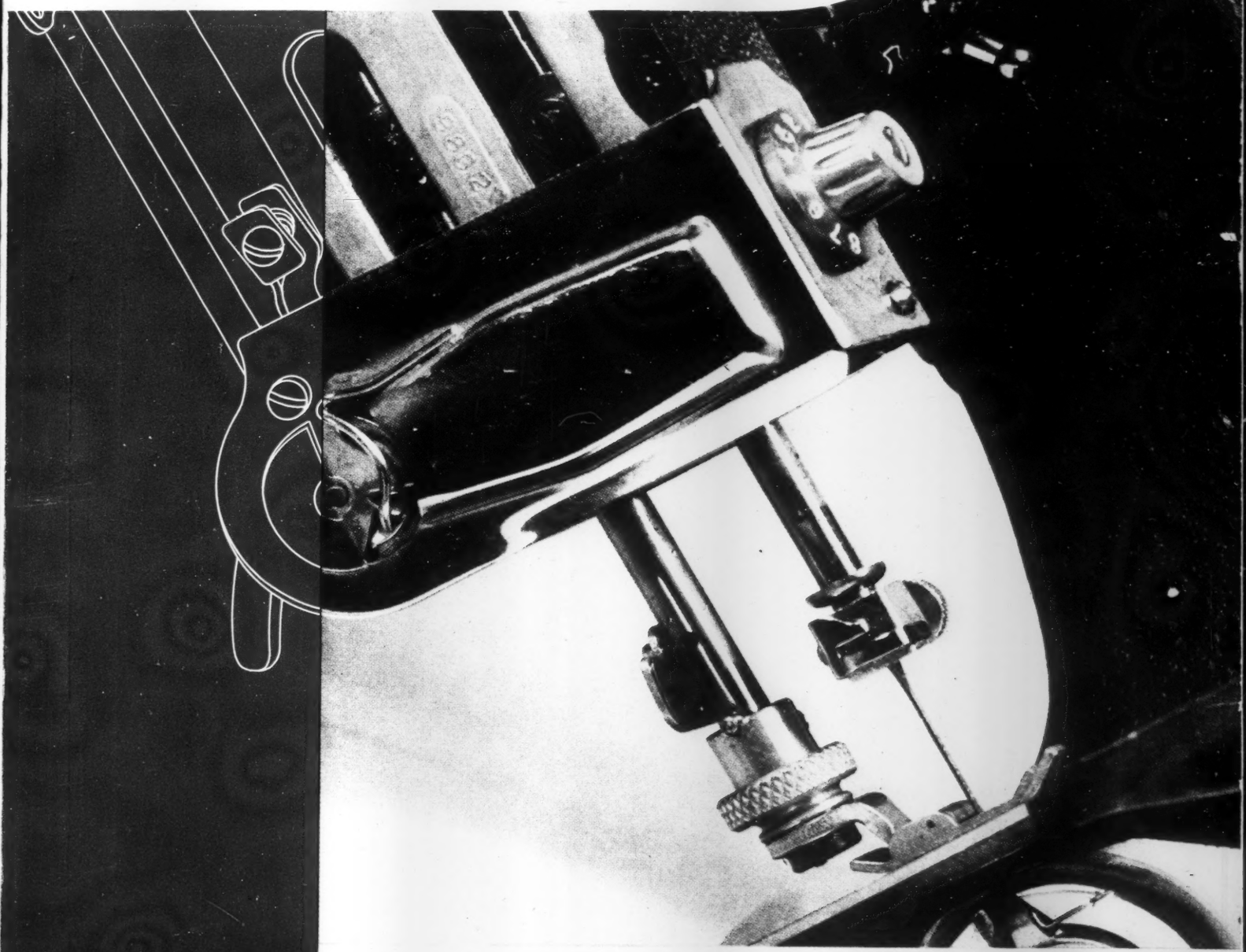
Feb-47
Wichita City Library

MACHINE DESIGN

February 1947

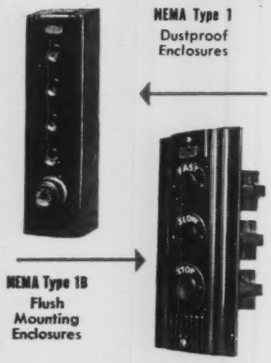


In This Issue: NEW DEVELOPMENTS IN PLASTICS
PORCELAIN ENAMEL FINISHES . . . NEW TRADEMARK LAW

NEW LINE

C-H SPECIAL SERVICE

Heavy Duty Pushbutton Enclosures



Also a complete line of one-hole and base mounting elements without enclosure.

NEMA 4 Water-tight
NEMA 5 Dust-tight
NEMA 7 For hazardous Vapors
NEMA 9 For hazardous Dust
From 1 to 6 Heavy Duty Elements

Also Oil-tight Construction

Oil-tight construction that really keeps oil out. Oilproof Neoprene gaskets positively prevent oil seepage.

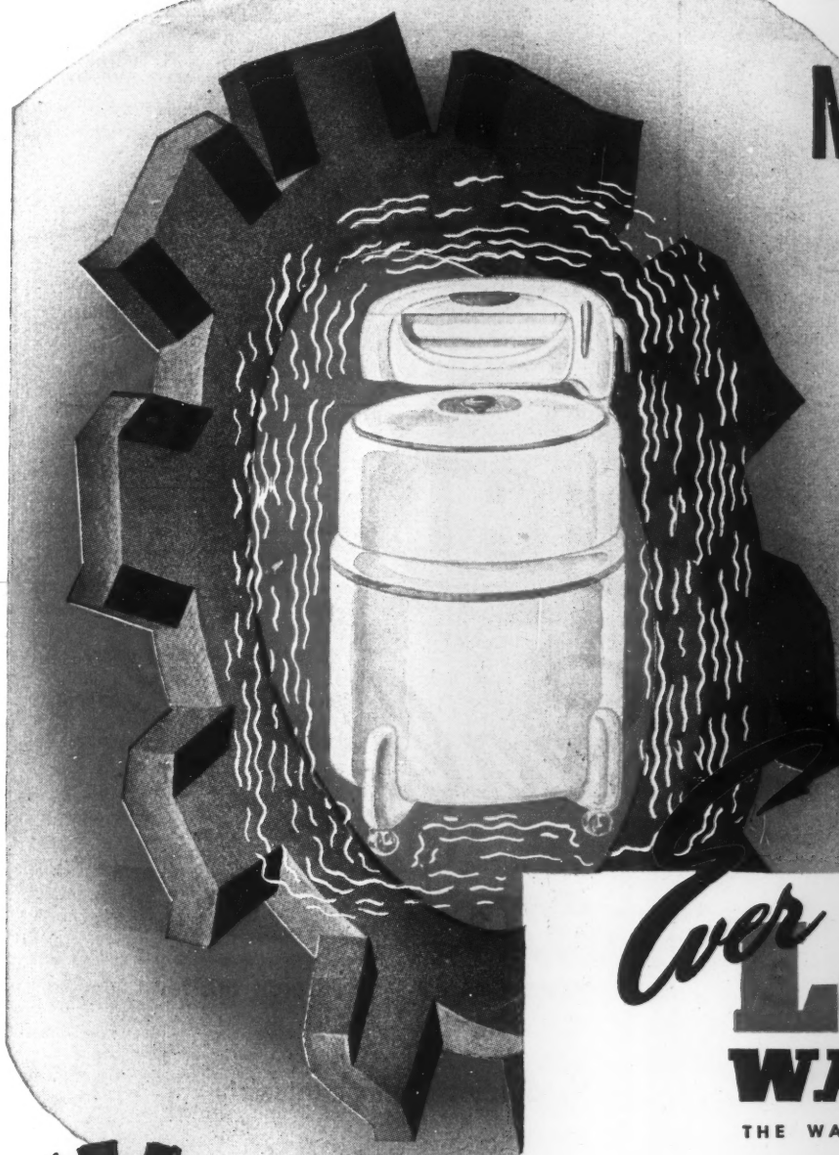
Cutler-Hammer now offers a broad range of pushbutton stations and pushbutton elements for special service of every kind.

Typical of the line, the oil-tight stations conforming to automotive and machine tool standards, offer superlative engineering. *Oilproof* Neoprene gaskets positively seal out oil; large rugged terminals abolish the need to form a loop in wiring; oversize mushroom type operating buttons with drip-hoods and guard flanges . . . these are just a few of the scores of construction, operation and installation superiorities that show why machine builders and machine users prefer Cutler-Hammer pushbutton elements and stations and say they have no equal. Write for full information today. CUTLER-HAMMER, Inc., 1310 St. Paul Ave., Milwaukee 1, Wis. *Associate:* Canadian Cutler-Hammer, Ltd., Toronto, Ontario.

CUTLER-HAMMER
MOTOR CONTROL
C-H

Wichita City Library

IF YOUR ASSEMBLIES MUST TAKE TEETH RATTLING PUNISHMENT YOU NEED



Standard 80° Countersunk EverLOCK

Standard Internal EverLOCK

Standard External EverLOCK

Standard Internal-External EverLOCK

Ever LOCK WASHERS

THE WASHER THAT HAS THE EDGE

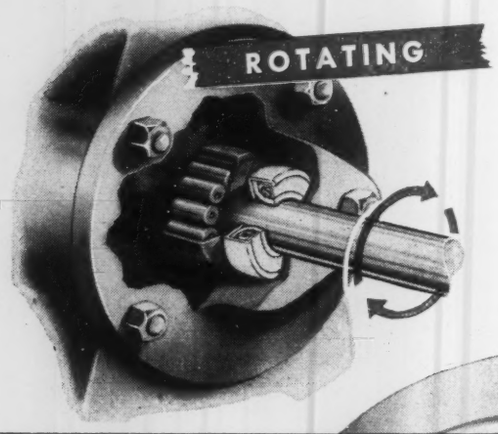
By providing more grip in the center of action, EverLOCK Washers enable your assemblies to defy the loosening action of vibration, impact, expansion and contraction.

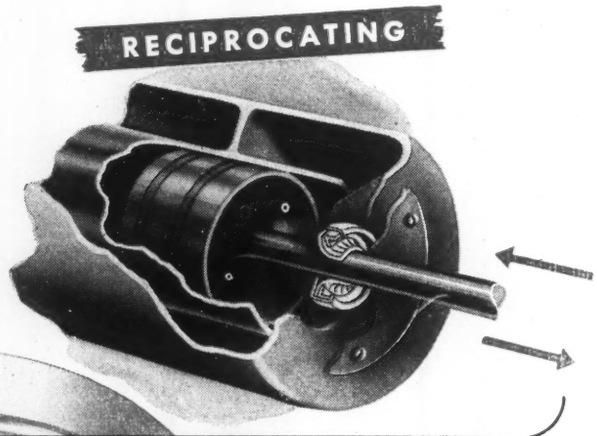
Each of EverLOCK'S many wide chisel edges provide extra holding power—combine with balanced spring tension to provide a distinctive 2-way locking action.

Speed and ease of application save time and labor. A half turn or less gives a positive lock—eliminates all hazards of stretched bolts or distortion of threaded parts.

THOMPSON-BREMER & CO., 1656 W. HUBBARD ST., CHICAGO 22, ILL.

The Simple Effective Way to Seal Shafts





"PERFECT" *Oil Seals*

PATENTED

THEY DO:	THEY DO NOT:
1—Retain lubricant	1—Permit entrance of foreign matter
2—Prolong bearing life	2—Need adjustment or attention
3—Reduce bearing maintenance	3—Rotate with the shaft
4—Use little space	4—Wick lubricant away from bearing
5—Cost very little	5—Score the shaft

Consult Chicago Rawhide Engineers for Specific Application Information

25

CHICAGO RAWHIDE MANUFACTURING COMPANY

1304 ELSTON AVENUE • CHICAGO 22, ILLINOIS

PHILADELPHIA • CLEVELAND • NEW YORK • DETROIT • BOSTON • PITTSBURGH • CINCINNATI

67 YEARS MANUFACTURING QUALITY MECHANICAL LEATHER GOODS EXCLUSIVELY AND NOW SIRVENE SYNTHETIC PRODUCTS

MACHINE DESIGN

THE PROFESSIONAL JOURNAL OF CHIEF ENGINEERS AND DESIGNERS

EDITORIAL STAFF

Laurence E. Jermy, Editor

John W. Greve, Managing Editor

Associate Editors

Colin Carmichael Richard K. Lotz

Roger W. Bolz

Assistant Editors

Harry Raech Jr. H. N. Goga

Frank H. Burgess, Art Editor

New York....D. K. Price, L. E. Browne
Chicago.....Erle F. Ross
Pittsburgh.....J. C. Sullivan
Detroit.....A. H. Allen
Washington.....L. M. Lamm
London.....Vincent Delport

BUSINESS STAFF

G. O. Hays, Business Manager

Mary L. Callahan, Advertising Service

Chicago.....H. H. Dreyer, Manager
New York.....R. H. Smith, Manager
E. S. Lawson, Asst. Manager
Cleveland.....H. B. Veith, Manager
Los Angeles.....F. J. Fuller, Manager

CIRCULATION & RESEARCH

J. W. Zuber, Director
Jack C. Gernhard, Readers Service
R. L. Hartford, Market Research
J. G. Doolittle, Field Representative

MAIN OFFICE

Penton Building, Cleveland 13, Ohio

BRANCH OFFICES

New York 17.....16 East 43rd St.
Chicago 11.... 520 North Michigan Ave.
Pittsburgh 19....2800 Koppers Building
Detroit 2.....6560 Cass Ave.
Washington 4...956 National Press Bldg.
Los Angeles 4 130 N. New Hampshire Ave.
London, S.W.1 2 Caxton St., Westminster

Published by The Penton Publishing Co. E. L. Shaner, Pres. and Treas.; G. O. Hays, Vice Pres. and Gen. Mgr.; R. C. Jaenke, Vice Pres.; F. G. Steinebach, Vice Pres. and Secy.; E. L. Werner, Asst. Treas. Published on the seventh of each month.

THIS MONTH'S COVER: Head for White sewing machine. Model shown utilizes a rotary shuttle having variable speed during stitching cycle. Features of this motion are discussed in the article beginning on Page 136.

CONTENTS

February, 1947 Vol. 19, Number 2

What's New in Plastics—developments in materials, processes, applications . 101
By John Delmonte

Scanning the Field for Ideas . . . 106

Escapement Mechanism—improved by redesign . . . 110
By F. G. Kelly and J. L. Zar

Production Processes—XX—Impact Extrusion . . . 115
By R. W. Bolz

Photogrid Process—applied to problems in machine design . . . 120
By G. A. Brewer

Highlights from Machine Design Group Meeting . . . 123

Unsymmetrical Sections—procedure for calculating section properties . . . 129
By A. B. Cox

Trademarks for Machines—their selection and protection . . . 133
By George V. Woodling

Household Sewing Machine Passes Century Mark . . . 136

Which Cast Steel? Part III—Influence of Processing Operations . . . 138
By E. J. Wellauer

Unique Dictating Machine—features novel mechanisms . . . 143
By Frank L. Moore and Robert J. Schneider

Porcelain Enamels for Machine Parts—new enamels, improved processing . . 147
By R. L. Fellows

Price Reductions Become Primary Aim (Editorial) . . . 151

Bending Stiffness of Beams with Ribs or Slots (Data Sheet) . . . 157
By R. L. Benford

Itemized Index . . . 7

Topics . . . 98

Designs of the Month . . . 152

Applications of engineering parts, materials and processes . . . 156

Assets to a Bookcase . . . 159

New Parts and Materials . . . 160

Engineering Dept. Equipment . . . 172

Design Abstracts . . . 174

Noteworthy Patents . . . 178

Men of Machines . . . 180

Business and Sales Briefs . . . 186

Calendar of Meetings . . . 192

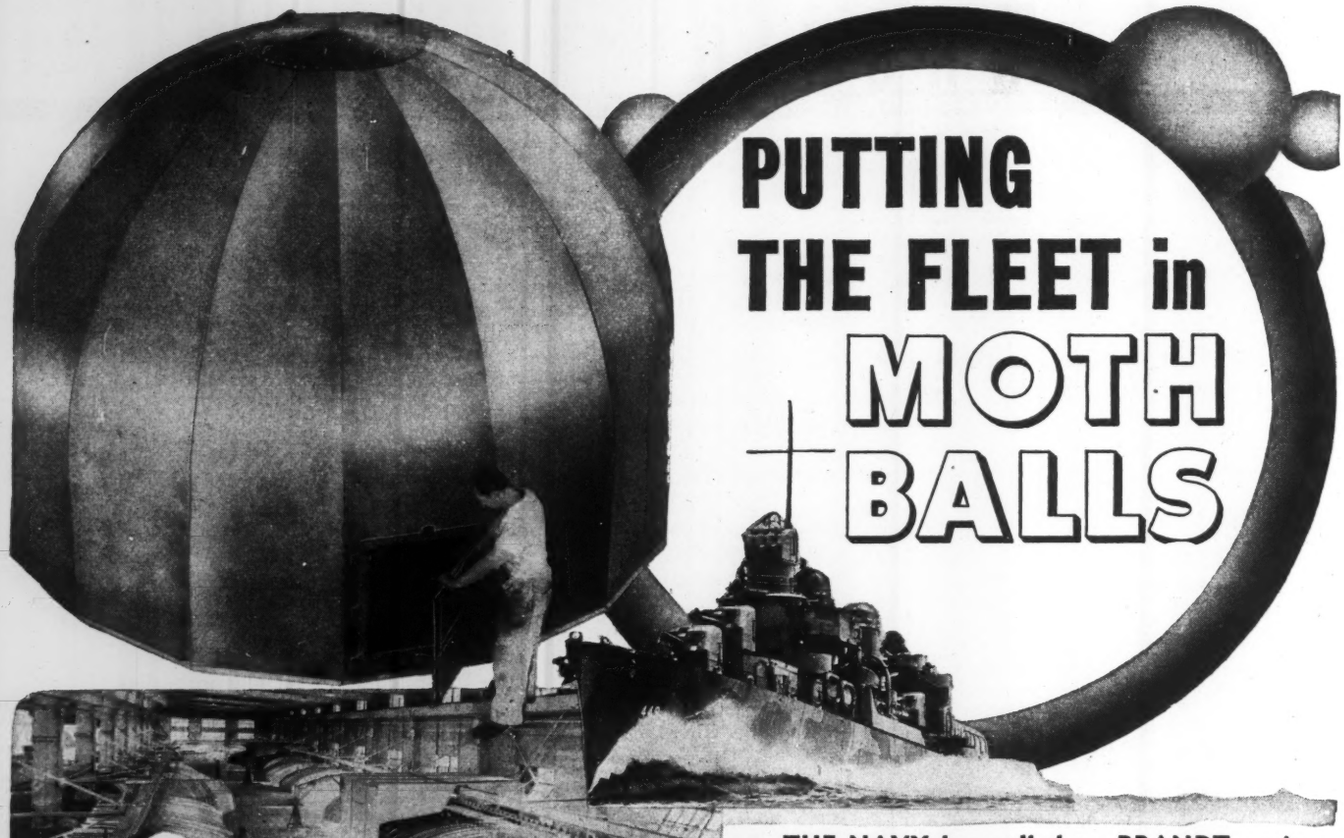
New Machines . . . 194

Helpful Literature . . . 287

Subscription in United States and possessions, Canada, Cuba, Mexico, Central and South America: One year $3.00. Single copies $1.00. Other Countries One year, $15.

Copyright 1947 by The Penton Publishing Company.

PUTTING THE FLEET in MOTH BALLS



THE NAVY has called on BRANDT again.

This time to build steel "Cans for Guns", . . . air tight protective structures for the preservation of valuable armament. These 16 gauge steel housings, 13 feet high by 15 feet in diameter, are being **mass produced** on an assembly line basis by Brandt.

"Time", being the essence of this contract, mass production methods are being applied to all operations including: Stamping, Forming, Arc and Spot Welding, Bonderizing, Painting, Assembling and Crating . . . all under the same roof.

These units, which are made in their entirety by Brandt, attest to the wide range of Brandt Specialized Metal Working facilities.

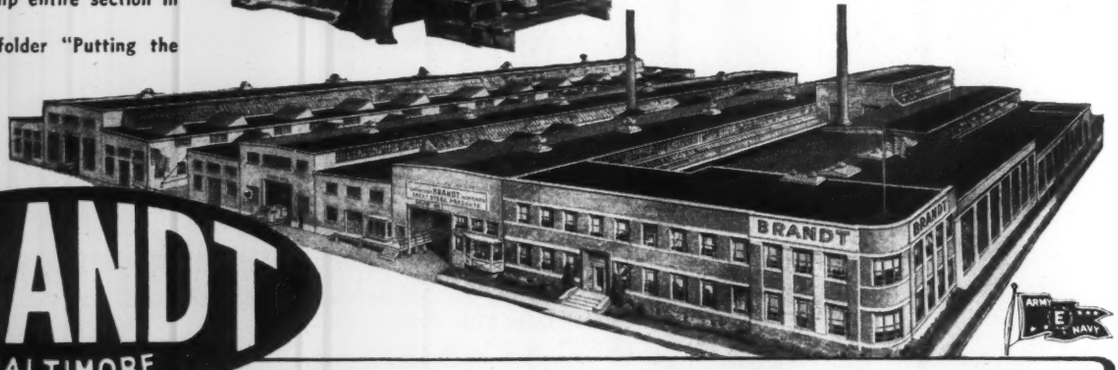
ILLUSTRATED:

Huge 16 gauge steel housing. Assembly line set up especially for the production of housings.

Arc welding air tight seams.

Hydraulic presses stamp entire section in one operation.

Send for illustrated folder "Putting the Fleet in Moth Balls".



BRANDT
BALTIMORE

CHARLES T. BRANDT, INC., 1700 RIDGELY ST., BALTIMORE-30, MD.

Precision METAL CRAFTSMEN SINCE 1890 ★ ★ ★ ★

BEVEL GEAR *Design? Manufacture? Application?*

WE OFFER YOU:

1. SOLUTIONS OF YOUR BEVEL GEAR DESIGN PROBLEMS,
2. ESTIMATES OF YOUR PRODUCTION TIME AND COSTS,
3. RECOMMENDATIONS ON THE RIGHT EQUIPMENT FOR YOUR NEEDS,

WITHOUT OBLIGATION.

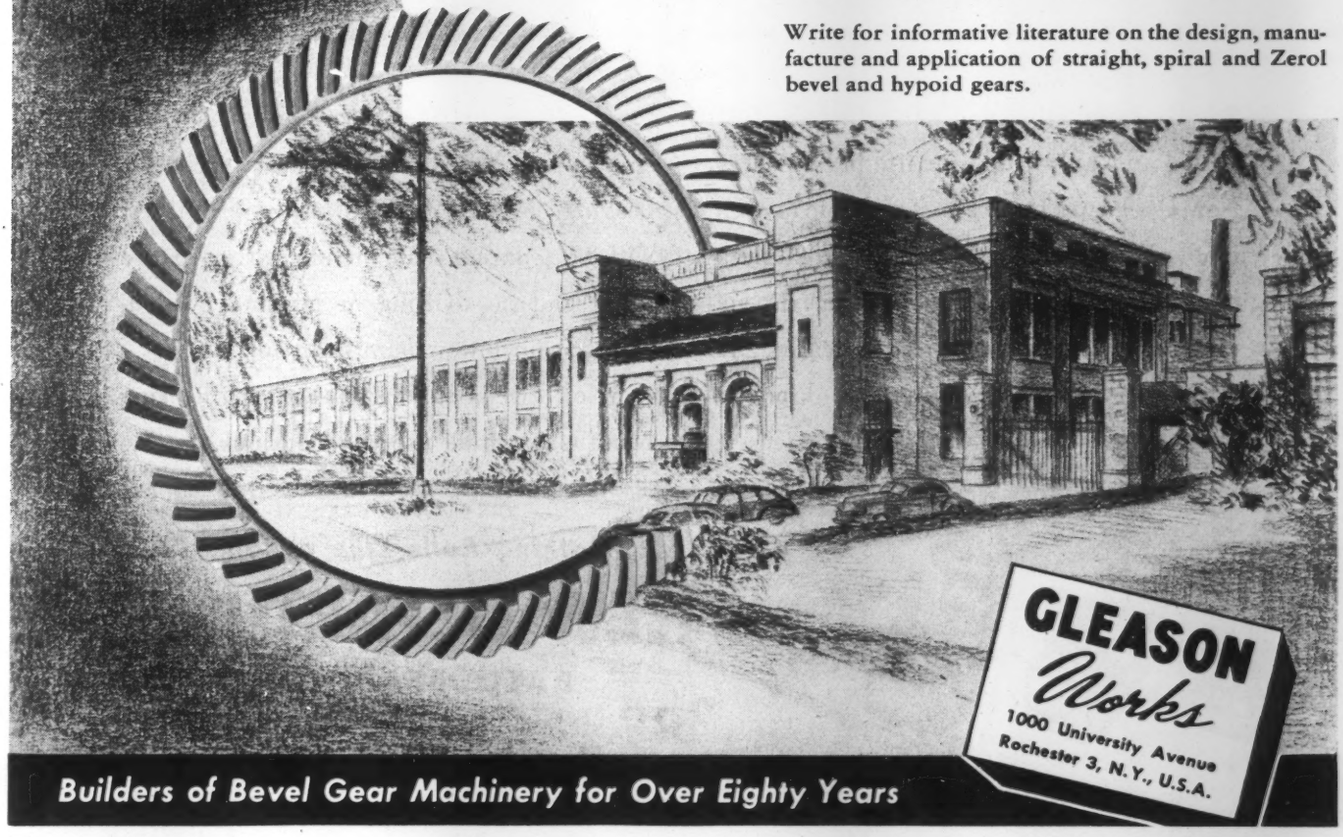
Highly skilled engineers backed by a wealth of experience in bevel gear design and manufacture will study your bevel gear drive designs, make suggestions, estimate production time and costs, and recommend the correct bevel gear manufacturing equipment.

Utilize the complete Gleason Engineering Service by sending us:

For production engineering: (1) Blueprints of your bevel gear designs, (2) Material specifications and manufacturing tolerances, (3) Quantity of gears to be produced per month, and (4) Number of working hours per month available for gear production.

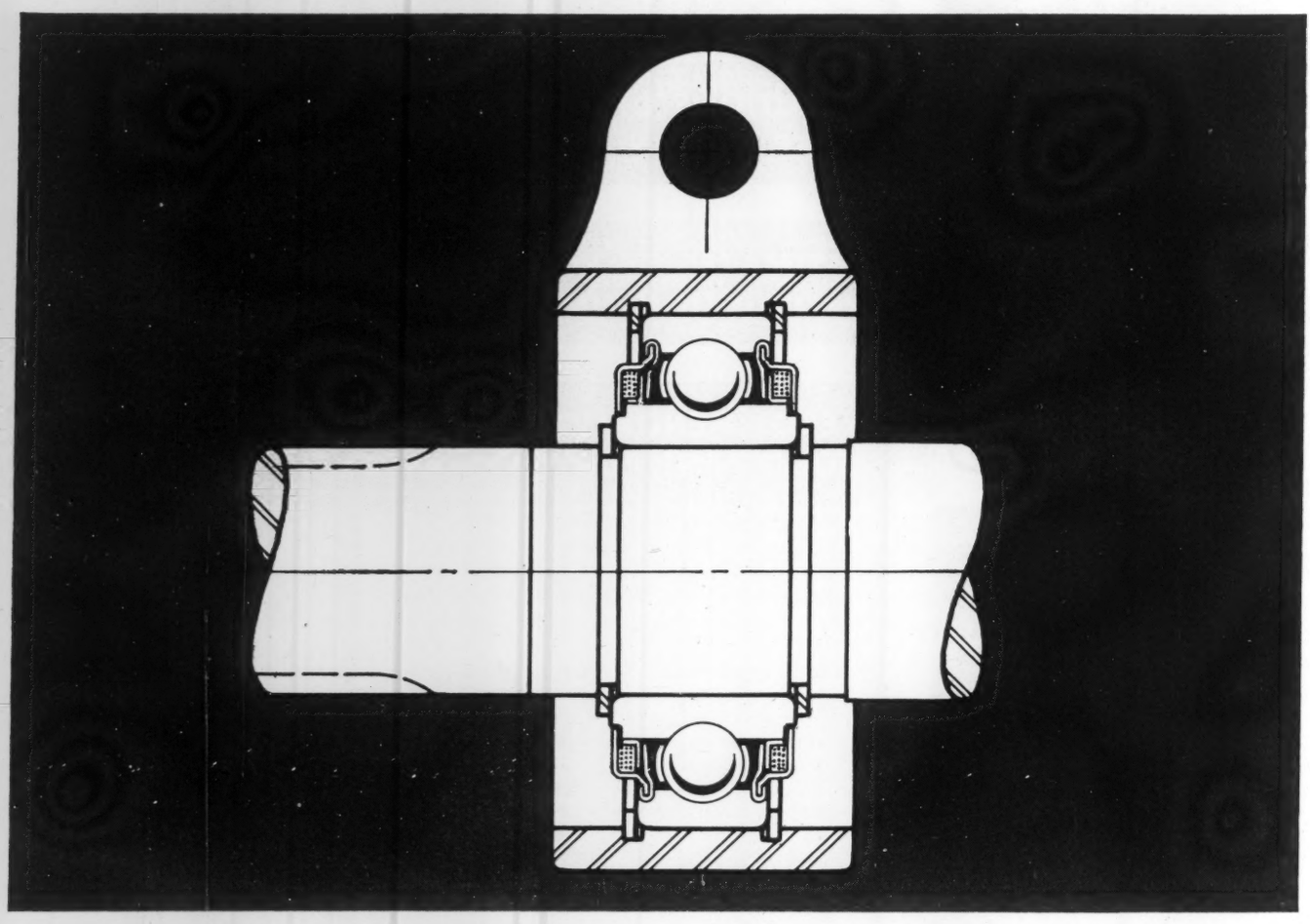
For design engineering: (1) Preliminary layouts or prints of proposed bevel gear drive designs, (2) Type of drive, (3) Horsepower and speed required, (4) Type of loading (constant, intermittent or shock), and (5) Driving member and direction of rotation.

Write for informative literature on the design, manufacture and application of straight, spiral and Zerol bevel and hypoid gears.



Builders of Bevel Gear Machinery for Over Eighty Years

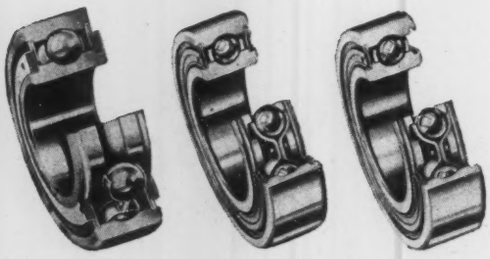
How creative engineering cuts ALL upkeep



● By originating and perfecting the self-sealed and Lubricated-for-life ball bearing, New Departure has made it possible to eliminate *all* maintenance work for a great number of important bearing positions in machinery of all sorts. No lubricating, no adjusting—no attention of any kind required.

And—as in the power take-off shaft shown, not only can the owner forget the bearing entirely, but the machine builder, with no separate seals or lubricating fixture to fit and no drilling or tapping needed, can save in lower manufacturing cost.

New Departure creative engineering benefits machine user *and* builder.



Nothing Rolls Like a Ball

NEW DEPARTURE

BALL BEARINGS

3454

NEW DEPARTURE • Division of GENERAL MOTORS • BRISTOL, CONN. • Branches in DETROIT, CHICAGO, LOS ANGELES and Other Principal Cities

Itemized Index

Classified for convenience when studying specific design problems

Design and Calculations

Amplifier tube without tuned circuit, Edit. 107
Ball bearing ratings, Edit. 127
Broaching machine design, Edit. 124
Cam design, Edit 127
Contours, checking variable sections, Edit. 106
Dictating machine design, Edit. 143-146
Dishwasher design, Edit. 152
Escapement mechanism, Edit. 110-113
Electronic measurement, Edit. 125
Impacted screws, Edit. 115-119
Motors, d-c, with wide speed range, Edit. 107
Photogrid process, Edit. 120-122
Plastics, new developments in, Edit. 101-105, 182, 184
Recording dilatometer design, Edit. 153
Resistance welding press design, Edit. 154
Steel castings design, Edit. 138-142
Stiffness of beams, with ribs and slots (Data Sheet), Edit. 157-158
Strength of machine parts, Edit. 123
Tool, power actuated, Edit. 108
Unsymmetrical sections, Edit. 129-132
Variable speed drive, Edit. 136-137

Engineering Department

Design service, Adv. 85
Equipment, Adv. 73
Instruments, Edit. 109, 168; Adv. 83, 167, 245
Management, Edit. 174
Supplies, Adv. 293, 295, 302, 313
Testing equipment, Edit. 106, 120-122, 159, 172; Adv. 185
Trademarks for machines, Edit. 133-136

Finishes

Enamel, Edit. 147-150
Protective coating, Edit. 159; Adv. 278

Materials

Adhesives, Edit. 166
Aluminum alloys, Adv. 68, 204, 205, 277
Brass, Adv. 197, 198
Bronze, Adv. 242, 253
Carbides, cemented, Adv. 301
Glass, Adv. 209
Magnesium alloys, Edit. 176; Adv. 14, 15, 36
Metals, laminated, Adv. 16
Molybdenum alloys, Adv. 179
Nickel alloys, Adv. 53
Plastics, Edit. 101-105, 182, 184; Adv. 49, 247, 273, 276
Rubber and synthetics, Edit. 156, 163; Adv. 26, 81, 231
Steel, Edit. 138-142; Adv. 263, 291
Steel, stainless, Adv. 20, 44, 45, 67
Zinc, Adv. 173

Parts

Bearings:
- Ball, Edit. 127, 161; Adv. 6, 11, 181, 200, 254, 314
- Needle, Adv. 65
- Roller, Edit. 161; Adv. 40, 213, 226, 238, 262, Back cover
- Spherical, Adv. 230
- Sleeve, Adv. 79, 165, 256, 279, 286, 297

Bellows, Adv. 215, 261, 267, 284
Belts and belting, Adv. 32, 84, 195, 290
Bushings, Adv. 300, 303
Cable controls, Edit. 178; Adv. 293, 309, 312
Cams, Edit. 127; Adv., 315
Carbon and graphite parts, Adv. 77, 292, 311
Castings:
- Centrifugal, Adv. 89
- Die, Adv. 75
- Investment, Adv. 17
- Sand, Adv. 94, 266, 317

Chains:
- Conveyor, Adv. 56
- Roller, Adv. 57, 249, 272

Clutches, Edit. 160; Adv. 64, 278, 299
Controls (see Electric, Cable, etc.)
Counters, Adv. 227, 302
Couplings, Adv. 61, 86, 87, 255, 268, 284, 315
Electric accessories, Edit. 164; Adv. 294
Electric controls:
- Capacitors, Edit. 170; Adv. 59
- Contactors, Edit. 178
- Contacts, Edit. 160
- Control assemblies, Edit. 166, Adv. 243
- Electronic, Edit. 107, 125
- Rectifiers, Edit. 162
- Relays, Edit. 162, 166; Adv. 24, 289
- Starters, Adv. 33, 34, 55
- Switches, Edit. 166, 168, 170; Adv. Inside front cover, 92, 93, 304
- Thermostats, Edit. 163, 170; Adv. 296

Electric generators, Adv. 244
Electric motors, Edit. 108, 161, 164, 166, 178; Adv. 35, 39, 47, 70, 71, 74, 78, 82, 96, 177, 202, 203, 223, 225, 301, 309, Inside back cover
Engines, Edit. 160, 174; Adv. 13, 285, 290, 292, 298
Fabric parts, Adv. 310
Fastenings:
- Locking, Edit. 161; Adv. 1, 30, 191, 257, 260, 280, 293, 294, 306
- Nuts, bolts, Adv. 8, 18, 175, 192, 214, 216, 218, 232, 264, 283, 320
- Rivets, Edit. 163

Felt parts, Adv. 280
Filters, Edit. 168; Adv. 62
Fittings, Adv. 12, 69, 72, 252
Forgings, Adv. 52, 219, 282, 296, 299
Gages, pressure, etc. (see Instruments), Edit. 25
Gears, Adv. 5, 23, 29, 186, 304, 308, 310
Generators (see Electric generators)
Heat exchangers, Adv. 90
Hose (see Tubing)
Hydraulic and pneumatic equipment:
- Accumulators, Adv. 196
- Controls, Edit. 161; Adv. 234, 306
- Cylinders, Edit. 163; Adv. 88, 220, 235
- Motors, Edit. 160; Adv. 246, 283
- Pumps, Edit. 163; Adv. 10, 41, 54, 91, 221, 229, 315
- Systems, Edit. 156; Adv. 9
- Valves, Edit. 164, 168; Adv. 99, 291, 296, 313

Instruments, Adv. 31
Joints, Adv. 212, 308, 312
Lamps and lighting, Edit. 172; Adv. 311
Leather parts, Adv. 217
Lubrication and equipment, Edit. 162; Adv. 80, 171, 251, 299
Machined parts, Adv. 292
Motors (see Electric Motors)
Mountings, vibration, Edit. 162
Nameplates, Adv. 187, 312
Pins, dowel, Adv. 188
Plastic parts, Edit. 101-105, 182, 184; Adv. 281
Pneumatic equipment (see Hydraulic and pneumatic)
Powder metal parts, Adv. 305
Pulleys and sheaves, Adv. 19, 258
Pumps (see also Hydraulic and pneumatic), Edit. 162; Adv. 21, 193, 218, 285, 298, 304, 307, 311
Rings, retaining, Adv. 265
Rolls, Edit. 170
Rubber and synthetic parts, Adv. 37
Seals, packings, gaskets, Edit. 163; Adv. 2, 27, 76, 95, 169, 206, 207, 222, 228, 240, 307
Seats, Adv. 303
Shafts, flexible, Adv. 294, 298
Sheet-metal parts, Adv. 4
Speed reducers, Adv. 38, 48, 100, 233, 236, 241, 284, 295, 303, 313
Springs, Adv. 28, 64, 199, 259, 300, 308
Transmissions, variable speed, Edit. 161; Adv. 50, 51, 290
Tubing:
- Metallic, Adv. 22, 42, 58, 60, 66, 183, 201, 208, 210, 211, 237, 248
- Nonmetallic, Edit. 164

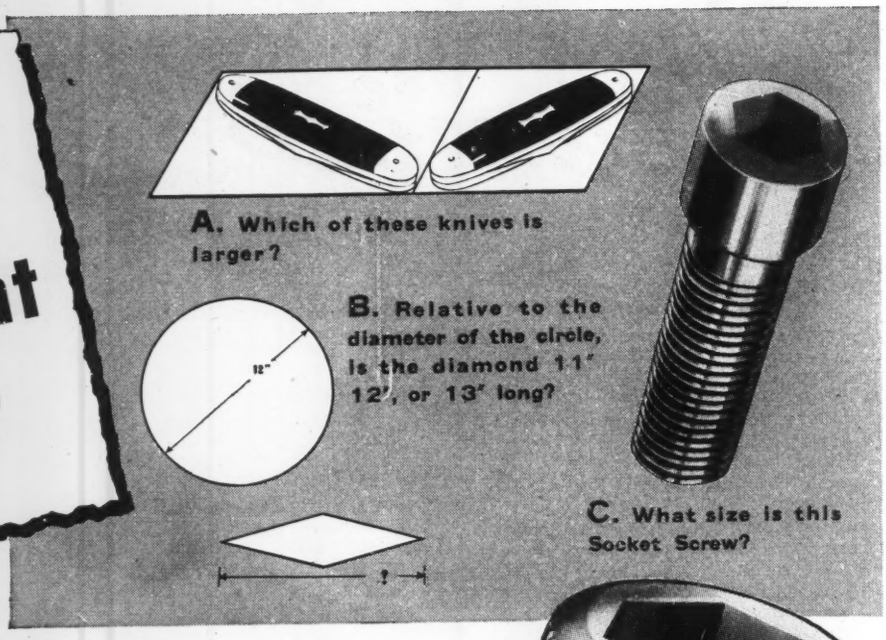
Universal joints, Adv. 190, 194
Valves (see also Hydraulic and pneumatic), Adv. 250, 269, 309
Weldments and equipment, Edit. 166; Adv. 239, 319
Wheels and casters, Edit. 160; Adv. 291, 302, 307
Wire and wire products, Edit. 132; Adv. 184

Production

Broaching, Edit. 124
Hardening, Edit. 108
Impacted screws, Edit. 115-119
Machines, special, Adv. 46, 97, 189, 224, 274, 275
Testing and equipment, Adv. 43, 306
Tools and accessories, Edit. 108

MACHINE DESIGN is indexed in Industrial Arts Index and Engineering Index Service, both available in libraries generally.

Can YOU Guess Right on Size?



GUESSING is fun in a game . . . but there's no place for it in shop practice. Wrong guesses cost money . . . and they happen more often than you think. For example, the size and thread pitch of the socket screw above was guessed wrong by many veteran shop men questioned in a recent test. On the job . . . such mistakes waste time.

There's no need to guess...

WHEN IT'S SIZE-MARKED

Just a quick glance at the head of any P-K Cap Screw reveals its size. Clearly incised, easily read, the Size-Mark represents a big forward step in the simplification of assembly operations.

Experienced men like the Size-Mark because it saves their time. Green hands are all for it because it protects them from errors. Tool crib bosses want it because it speeds up the sorting of left-over, mixed-up screws. And the men who service your products will appreciate the Size-Mark because it saves their time on reassembly jobs.

Are you missing this opportunity to aid your assembly workers – to speed up assemblies – and to provide an extra sales feature for your product?

Plus – GEAR GRIP*

Gear Grip on Size-Marked Socket Head Cap Screws is a further aid to fast work . . . makes them slip-proof even when fingers are oily. Write today for samples . . . Parker-Kalon Corp., 200 Varick St., New York 14, N. Y.

ANSWERS:

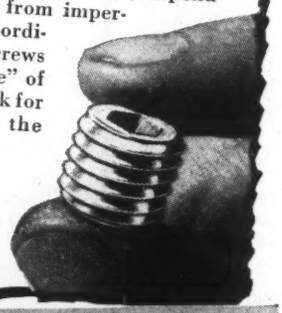
A. Both are the same. **B. The diamond is 13" long.**
C. There's no question when its's P-K Size-Marked!

* U. S. Pat. No. 126,409

ANOTHER **P-K** FIRST

GROUND THREAD
Socket Set Screws

● Smooth, mirror-bright, clean finished threads – centerless ground on hardened blanks. Accurate contour and lead, dependable Class 3 Fit. Free from imperfections common to ordinary cut thread set screws . . . a "shining example" of good workmanship. Ask for samples. You'll see the difference.



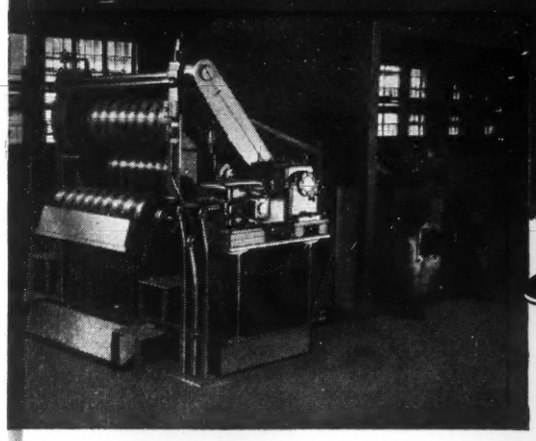
P-K SOCKET SCREWS ARE AVAILABLE FOR PROMPT DELIVERY!

Send for Stock List Now

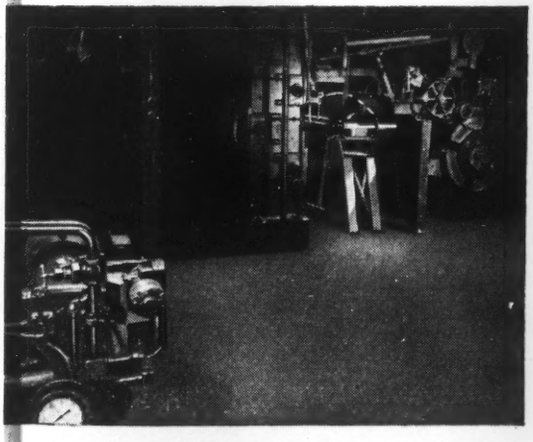
SOLD ONLY THROUGH ACCREDITED DISTRIBUTORS

PARKER-KALON *Cold-forged* SOCKET SCREWS

With Oilgear Pulling these ribbons



This photograph shows an Oilgear variable displacement motor driving the rolls which pull continuous ribbons of steel from unwinder reels on the floor below into the annealing furnaces at the right.



The Oilgear Fluid Power "generator" or pump (at the left) furnishes fluid power to the Oilgear motor in photo No. 1, and to the second Oilgear constant displacement motor shown here. *This* Oilgear motor powers the rolls which pull the steel ribbons from the annealing furnaces, through plating tanks and a drying tower; it also powers the rewind reels shown at the right.

Pulling endless thin ribbons of steel through several hundred feet of equipment can become a headache . . . if the ribbon tension varies, or if one drive unit gets out of step.

Yet, handling such steel ribbons—for making steel strapping, barrel hoops, etc.—is a major part of the business of the Acme Steel Co. of Chicago and Riverdale, Illinois.

Twelve years ago, to learn how best to keep out of trouble, how best to keep production running smoothly, Acme installed two drives on identical equipment. One was an all-electric drive. The other an Oilgear Fluid Power Drive.

Mr. S. Rasul, Chief Engineer of the Riverdale Works, Acme Steel Company, writes as follows: "For over ten years Oilgear 20 and 35 H.P. drives have been operating our Steel Unit-Load processing Equipment 24 hours per day, six and seven days per week with negligible maintenance. Each drive is started and stopped frequently. Quick, cushioned hydro-dynamic braking eliminates wasteful over-run. Simple remote push-button controls at several stations provide quick synchronous starting and stopping of complete drives. For our work they have proved very satisfactory. Oilgear drives are also applied to coil winders and oscillating machines and are being used on new additional equipment now under construction."

All these advantages are gained simply, without special engineering provisions, by means of versatile, flexible Oilgear Fluid Power which probably can solve a majority of your drive problems too. Why don't you investigate Oilgear, foremost in fluid power? THE OILGEAR COMPANY, 1305 W. Bruce St., Milwaukee 4, Wisconsin.

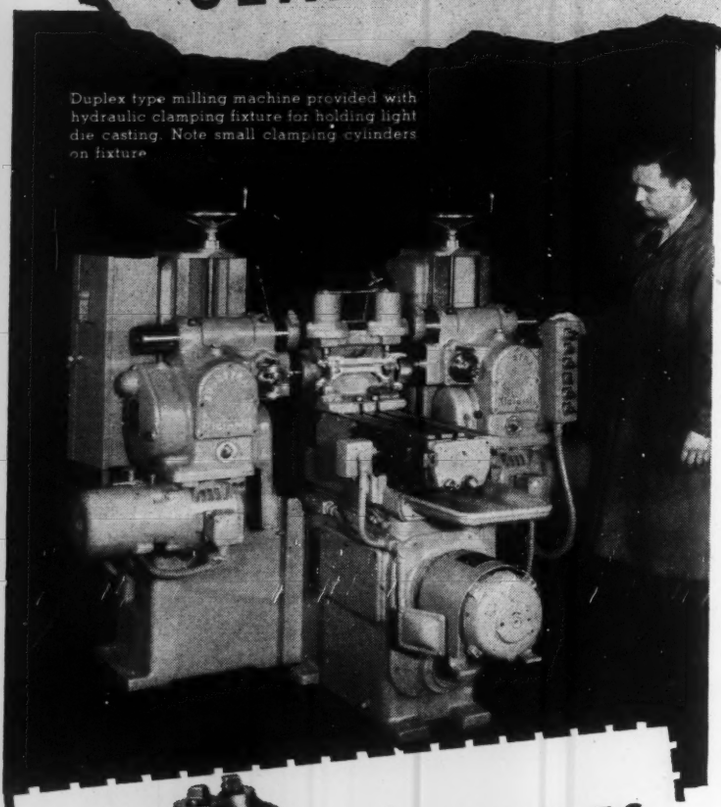
ARE YOU TRYING TO:

1. Apply large forces through long . . . or short . . . strokes at variable speeds?
2. Obtain automatic work cycles, variable speeds in either direction . . . with or without preset time dwell?
3. Apply large forces through continuous or intermittent reciprocating cycles at constant or variable velocities?
4. Obtain extremely accurate control of either position or speed of a reciprocating member?
5. Apply accurately variable pressure either static or in motion?
6. Closely synchronize various motions, operations or functions?
7. Apply light . . . or heavy . . . forces at extremely high velocities through either long or short distances of travel?
8. Obtain continuous automatic reversing drives at constant R.P.M. or over a wide range of speed variation?
9. Obtain accurate remote control of speed and direction of rotation, rates of acceleration and/or deceleration?
10. Obtain constant horsepower output through all or part of a speed range?
11. Obtain automatic torque control?
12. Obtain accurately matched speed of various rotating elements?
13. Obtain constant speed output from a variable speed input?
14. Obtain full preset automatic control, elimination of problems of shock, vibration, etc.?

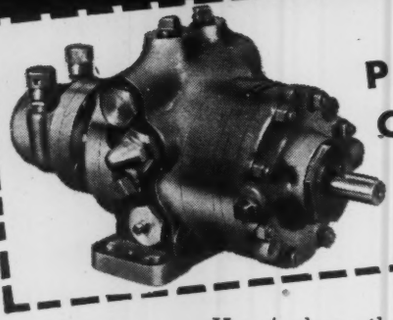
You Need Oilgear!

Oilgear Fluid Power

CONSISTENTLY UNIFORM HYDRAULIC CLAMPING PRESSURE *from...*



Duplex type milling machine provided with hydraulic clamping fixture for holding light die casting. Note small clamping cylinders on fixture



PROVIDES COMPACT DESIGN

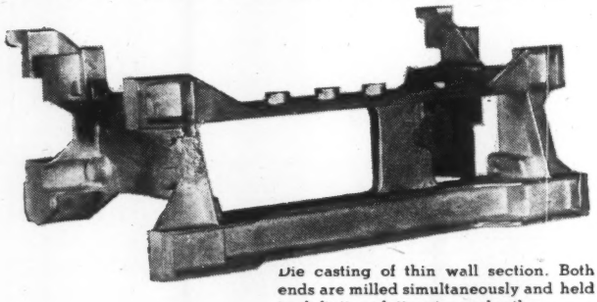
Here's how the hydraulic equipment has been incorporated into the design of a small duplex milling machine. The auxiliary clamping pump, the feed and traverse pump are all in one compact unit in the machinery base. Only two lines project from the machine base to the small clamping cylinders on the fixture.

THE SAME UNIT THAT GIVES YOU FEED AND TRAVERSE

Here's a simple efficient method of obtaining power clamping for accurate machining. Consistently uniform clamping pressure is obtained by merely adding—at relatively small extra cost—a compact auxiliary clamping pump to the PWX feed and traverse pump.

Eliminates Distortion in Light Metal Parts or Thin Wall Castings

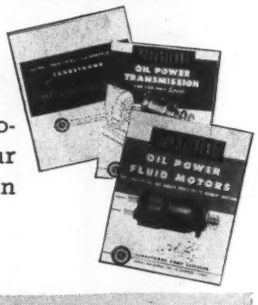
The wide range of pressure adjustment with hydraulic clamping makes it possible to obtain the exact pressure required to hold light metal or thin walled parts accurately and without distortion.



Die casting of thin wall section. Both ends are milled simultaneously and held in definite relation to each other

MORE FREE DATA

is included in these up-to-date bulletins. Write for your copies today. Ask for bulletin No. M-14.

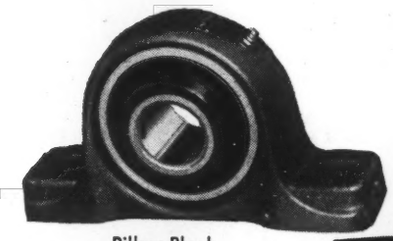


SUNDSTRAND MACHINE TOOL CO. · ROCKFORD ILLINOIS U.S.A.

SUNDSTRAND PUMP DIVISION

2559 ELEVENTH STREET • ROCKFORD, ILLINOIS

FUEL UNITS • HYDRAULIC PUMPS • TRANSMISSIONS • FLUID MOTORS • VALVES and CONTROLS

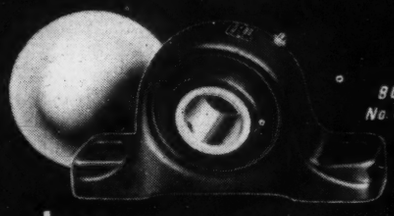


Pillow Block
Solid Housing
Medium Series 300

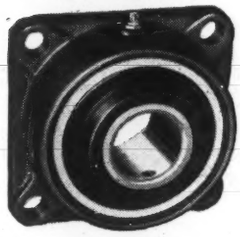
Pillow Block
Spilt Housing
Light Series 200

Pillow Block
Split Housing
Medium Series 300

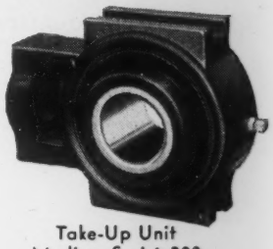
BALL BEARINGS



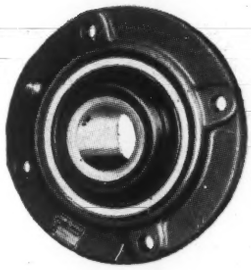
by LINK-BELT



Flange Unit
Medium Series 300

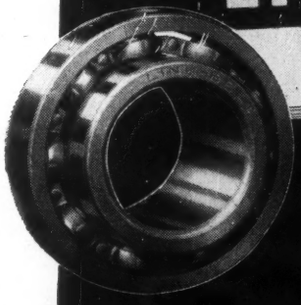


Take-Up Unit
Medium Series 300



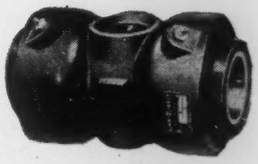
Flange Cartridge Unit
Medium Series 300

Pillow Block
Solid Housing
Light Series 200

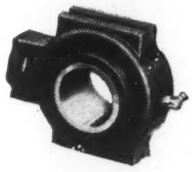


May we send you a copy of Link-Belt Book No. 2094, describing the various Link-Belt Ball Bearing Units shown here. Book contains engineering data, capacities and dimensions. Also send for Book No. 2095 covering Link-Belt Roller Bearings. Link-Belt Ball & Roller Bearings are sold by all Link-Belt Offices and Distributors throughout the country.

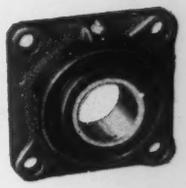
Cartridge Unit
Medium Series 300



Hanger Unit
Light Series 200



Take-Up Unit
Light Series 200



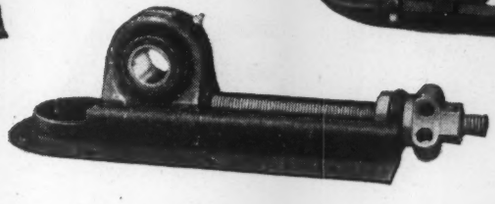
Flange Unit
Light Series 200

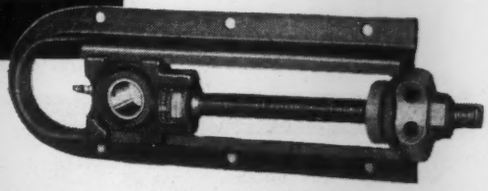
LINK-BELT COMPANY

Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Dallas 1, Houston 2, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8. Offices, Factory Branch Stores and Distributors in Principal Cities.

Self-Aligning Take-Up Unit
(Protected Screw Type)

Self-Aligning Take-Up Unit
Light Series TBS-200





Self-Aligning Take-Up Unit
Light Series TAS-200

10,508

No Limit on Standardization of Integral Piping Equipment . . .

ONE
SOURCE OF SUPPLY
RESPONSIBILITY
STANDARD OF QUALITY

. . . **For a compressor, for example,** or any fluid-handling design on your boards: Choose everything from the Crane line—without any compromise.

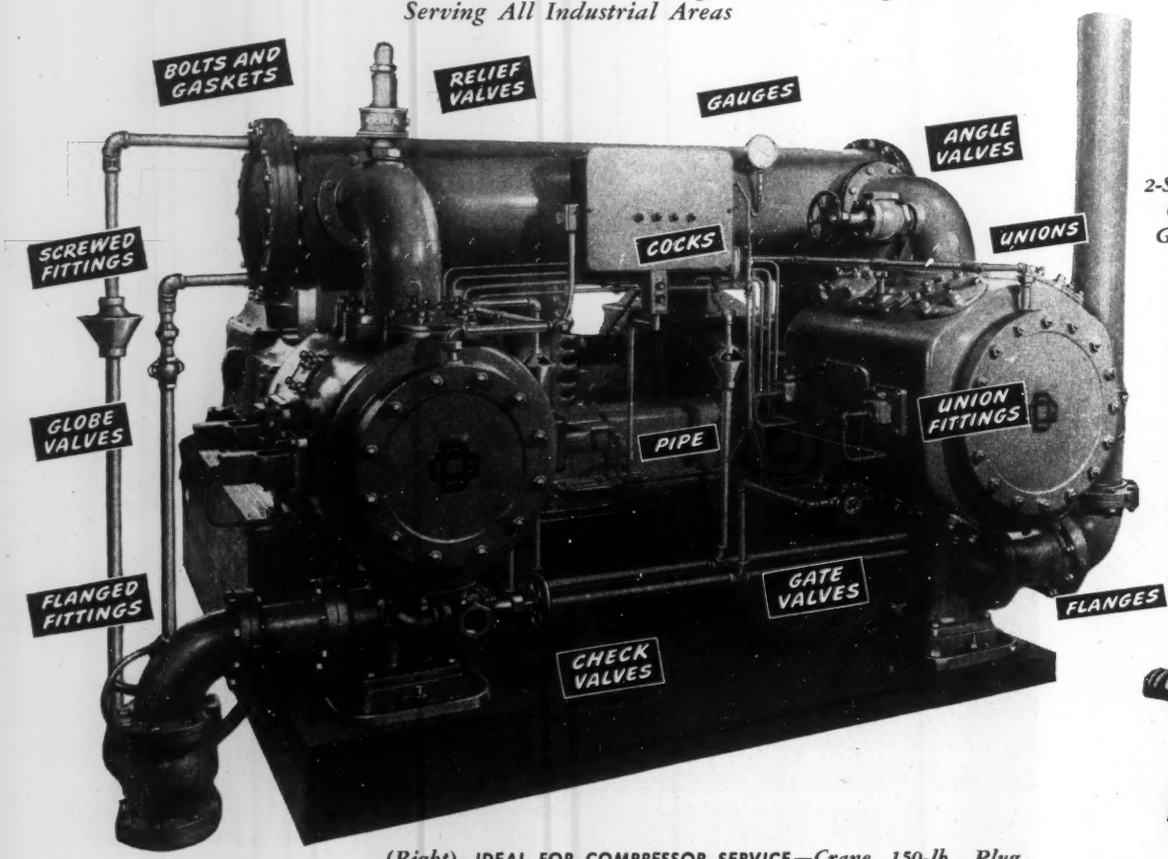
Go as far as you like—and be right every time in standardizing on Crane quality piping materials. It's the only line combining this 3-way advantage to the benefit of product designer and builder as well as your customer.

WORLD'S MOST COMPLETE SELECTION of brass, iron, and steel piping equipment for all applications. One source supplies everything: valves, fittings, pipe, piping accessories, and fabricated piping. A time-saver—from specification writing to finished product.

UNDIVIDED RESPONSIBILITY simplifies every step of equipment buying and stocking. Assures smooth piping assembly operations.

OUTSTANDING QUALITY IN EVERY ITEM guards the performance of your design; helps it win acceptance. Crane on the piping is the sign of added value to machinery buyers in every field.

Crane Co., 836 S. Michigan Ave., Chicago 5, Illinois. *Branches and Wholesalers Serving All Industrial Areas*



2-Stage Horizontal Compressor by Gardner-Denver Company

(Right) **IDEAL FOR COMPRESSOR SERVICE**—*Crane 150-lb. Plug Type Disc brass globe and angle valves. Extra-wide seating surfaces of hard-wearing metals provide maximum resistance to wire-drawing and damage by foreign matter. Disc taper permits accurate flow regulation. Rated at 150 lb. steam; 300 pounds cold working pressures. Sizes to 3 in. Complete specifications in your Crane Catalog.*

EVERYTHING FROM . . .

VALVES • FITTINGS
PIPE • PLUMBING
HEATING • PUMPS

CRANE

FOR EVERY PIPING SYSTEM

ANNOUNCING...

A New Source of Light-Weight, Air-Cooled Industrial Gasoline Engines

ENGINES NOW IN MASS PRODUCTION

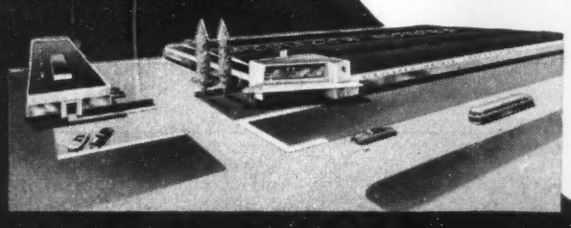
Capacity production of engines in the new McCulloch plant is more than one-a-minute. This includes special and standard types. In 75,000 square feet under roof, the new plant contains modern equipment for precision mass-manufacture, including 7 new die-casting machines, mechanized conveyors, tool and die sinking departments, and other machinery and automatic devices of the latest type. Current production is concentrated on Series 1200 engines, from 2½ to 4 hp. These are 2-cycle engines of conventional type in some respects but with such important exceptions as the following:

INTERESTING DESIGN FEATURES

Separate pressure oil system eliminates mixing oil with gas. This assures correct lubrication and prevents plug fouling. These are the first American-made, 2-cycle gasoline engines with this improvement.

Unusual light weight and durability result from the use of high-pressure, aluminum-alloy die castings for **all** major parts (except rods, crankshafts, and cylinder sleeves).

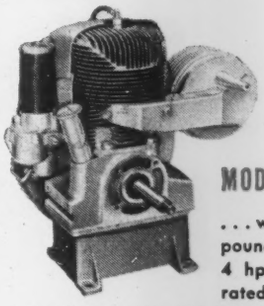
Radically improved scavenging is obtained from the patented McCulloch "reverse-flow" system, which accomplishes superior directional control of incoming fuel charges by means of **flat-top pistons** and intake-port **guide vanes.** • **Fuel injection** and pressure carburetion are available for special applications.



Send for illustrated brochure

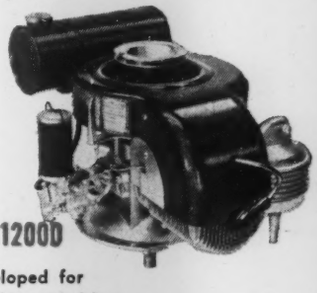
Standard or Special Engines

Series 1200 engines are available in standard types, such as the models 1200C and 1200D shown here. We also design and build special models, as illustrated by the model 1200B.



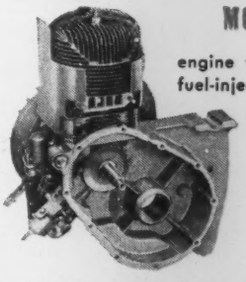
MODEL 1200C

. . . weighs only 24 pounds, yet develops 4 hp at 4000 rpm rated speed . . . has separate pressure oil system . . . displaces 6.28 cubic inches . . . bore and stroke 2 x 2 inches . . . one cylinder.



MODEL 1200D

. . . developed for applications requiring vertical power drive . . . rated 2.5 hp at 2500 rpm . . . weighs 24 pounds . . . separate oil system optional . . . one cylinder.



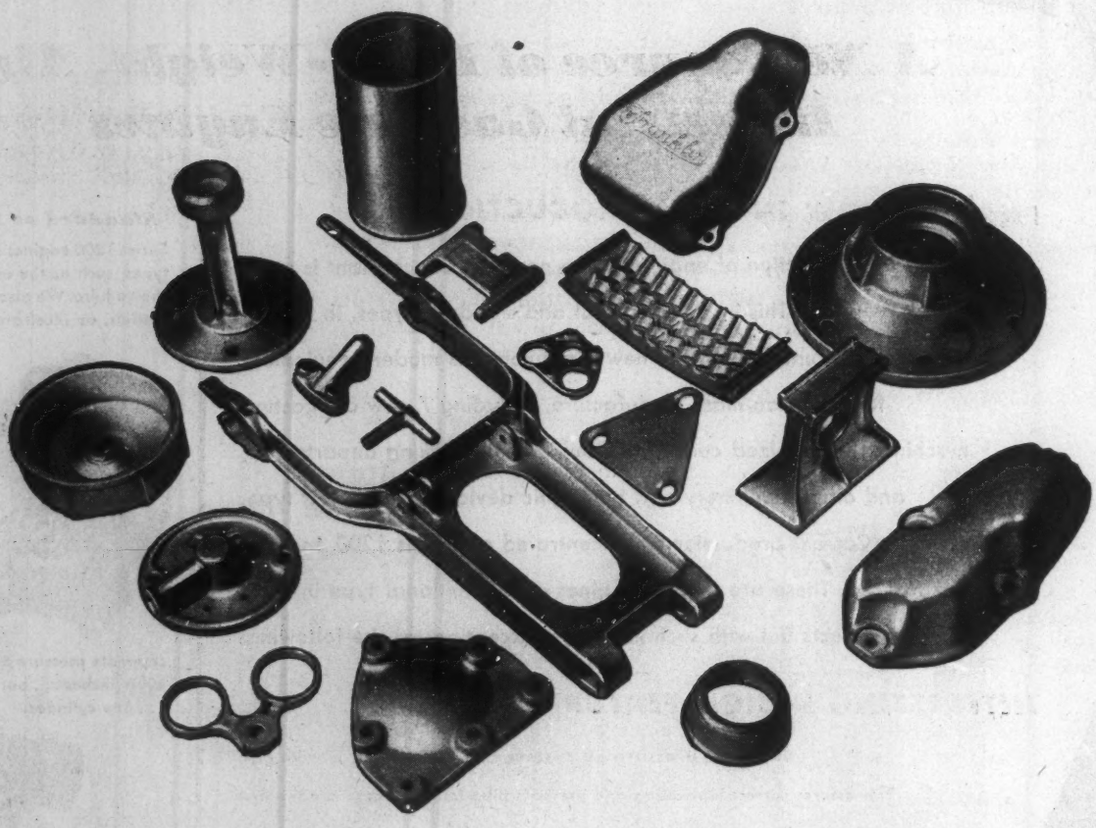
MODEL 1200B

engine with McCulloch fuel-injection system and die-cast block specially designed for a chain-saw application . . . this engine illustrates special designs we develop and build for manufacturers who wish to improve their products through the use of a functionally designed power plant.

McCULLOCH MOTORS CORPORATION

6101 WEST CENTURY BLVD.
LOS ANGELES 45, CALIFORNIA

Magnesium *Die Castings*



MECHANICAL PROPERTIES OF MAGNESIUM DIE CASTING ALLOY

ALLOY	CONDITION	TENSION			COMPRESSION		SHEAR	HARDNESS		IMPACT	FATIGUE
		Tensile Strength lb. per sq. in.	Yield Strength lb. per sq. in.	Elongation % in 2 inches	Ultimate Strength lb. per sq. in.	Yield Strength lb. per sq. in.	Ultimate lb. per sq. in.	Brinell 500 Kg. load 10 mm. Ball	Rockwell E	Charpy ft. lb.	Endurance limit at 500,000,000 cycles lb. per sq. in.
Dowmetal R	As Cast	33,000	22,000	3	58,000	22,000	20,000	60	72	2	14,000

COMPOSITIONS AND CHARACTERISTICS

ALLOY	NOMINAL COMPOSITIONS—PER CENT				CHARACTERISTICS
	Aluminum	Manganese	Zinc	Magnesium	
Dowmetal R	9.0	.02	0.6	Remainder	Alloy for general die casting use. Good casting characteristics combined with high mecnanical properties.

[1]Unless otherwise designated, values are typical. Minimum property values are guaranteed only when specified by the customer.

[2]Yield strength is defined as the stress at which the stress-strain curve deviates 0.2% from the modulus line.

[3]Standard A.S.T.M. die cast test bar.

This advertisement is adapted from the Dow Magnesium Catalog in Sweet's File for Product Designers.

See Sweet's or ask Dow for the complete catalog.

MAGNESIUM GIVES YOU

Magnesium is well adapted to the die casting process. The cost of magnesium die castings approximates that of competitive metals. As with other metals, the cost of the dies and die casting equipment makes necessary a relatively high production before die castings can be considered.

The advantages listed for magnesium sand and permanent mold castings apply equally well to magnesium die castings. In addition, die castings possess other advantages such as extremely accurate dimensions, economy in the amount of necessary machining, excellent surface finish, lower cost in quantity production, and additional weight saving by virtue of thin sections.

External threads can be die cast if the axis of the threads is in the parting plane. Internal threads and threads whose axes are not in the parting plane may be cast, but this necessitates loose pieces in the die. The good machinability of magnesium, however, makes it very easy to tap or otherwise thread in such cases.

The size of magnesium die castings is limited primarily by the available die casting equipment. Castings weighing up to five pounds and with a projected area of 250 square inches have been made.

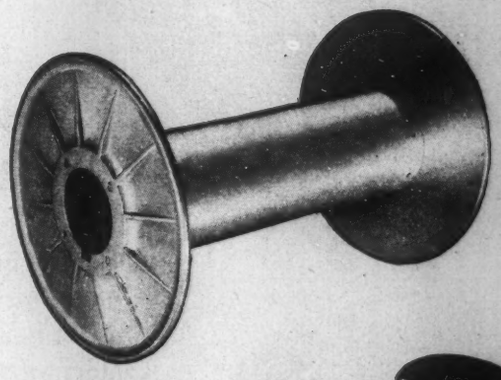
Section sizes are somewhat limited, but enough latitude can be secured to produce an extremely wide variety of parts. The preferred section thicknesses for magnesium die castings range from $\frac{1}{16}$ to $\frac{3}{16}$ inch, with a minimum thickness of 0.050 inch being recommended. Sections should rarely exceed $\frac{1}{2}$ inch in thickness inasmuch as heavy sections do not cast well.

The tolerances and limits that apply to magnesium die castings are approximately the same as those for other die casting metals. These tolerances are subject to variation, depending upon such features as the size and shape of the die casting, the die casting pressure employed, and other factors.

MAGNESIUM DIVISION
THE DOW CHEMICAL COMPANY
MIDLAND, MICHIGAN

New York • Boston • Philadelphia • Washington • Cleveland
Detroit • Chicago • St. Louis • Houston • San Francisco • Los
Angeles • Seattle • Dow Chemical of Canada, Limited, 204
Richmond Street West, Toronto 1, Ontario

DOW

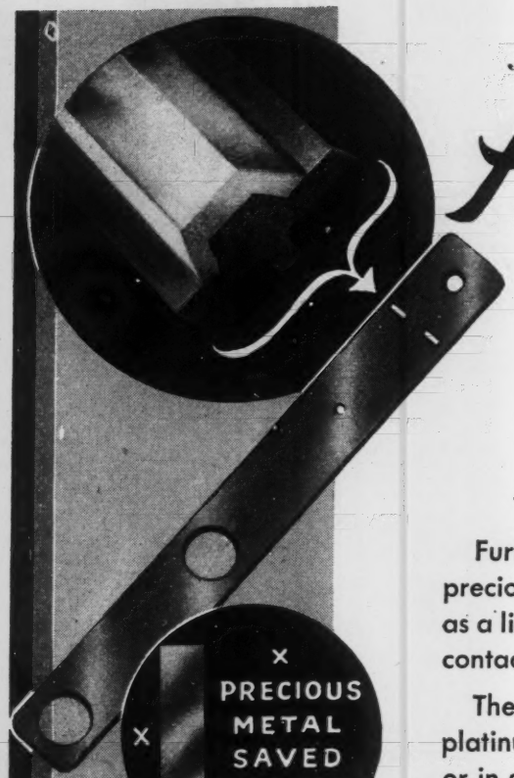


The die cast magnesium head of this textile warp beam is lighter and more rigid than the former steel part.

These business-like pruning shears, of magnesium die castings, weigh just 5½ ounces. Iron ones weigh 12 ounces.

Here's a sturdy little sidewalk bike with a die cast magnesium frame weighing only 2½ pounds.

The body of these handy, lightweight field glasses is a magnesium die casting, too.



ANNOUNCING

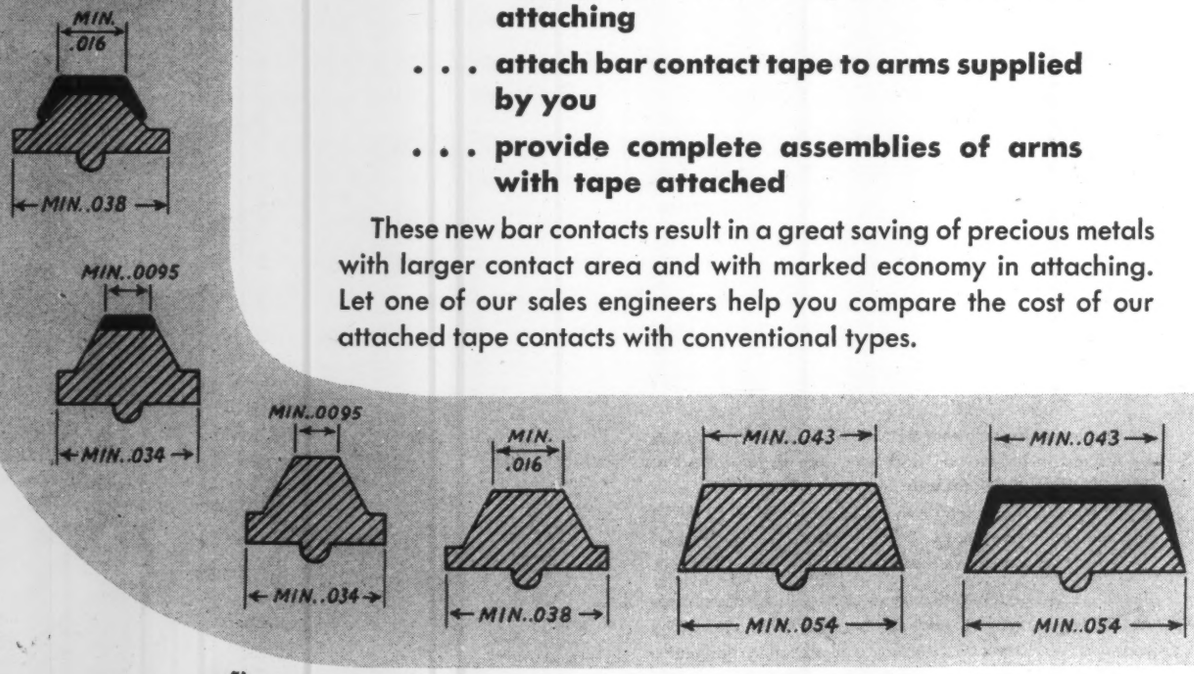
a new bar contact tape service by D. E. MAKEPEACE COMPANY under license arrangement with WESTERN ELECTRIC COMPANY, INC.

Further broadening our outstanding position in the laminated precious metal field, we are proud to announce our appointment as a licensee under Western Electric patents for manufacturing bar contact tape and attaching this tape to contact arms.

These bar contacts may be made in bi-metallic form of palladium, platinum or silver, pure or alloyed, on nickel or nickel silver . . . or in solid form of any precious metal or alloy. We are now prepared to —

- **. . . supply bar contact tape for your own attaching**
- **. . . attach bar contact tape to arms supplied by you**
- **. . . provide complete assemblies of arms with tape attached**

These new bar contacts result in a great saving of precious metals with larger contact area and with marked economy in attaching. Let one of our sales engineers help you compare the cost of our attached tape contacts with conventional types.



START RIGHT with **Makepeace** PRODUCTS

SHEETS • WIRE • TUBING • SOLDERS • FABRICATED PARTS AND ASSEMBLIES OF SOLID AND LAMINATED PRECIOUS METALS

D. E. MAKEPEACE COMPANY
Main Office and Plant, Attleboro, Massachusetts
NEW YORK OFFICE, 30 CHURCH ST. CHICAGO OFFICE, 55 EAST WASHINGTON ST.

18 Years Precision Casting Experience

MICROCAST PRECISION CASTINGS PROCESS

The TRADE MARK *for Genuine* High Precision CASTINGS

WHY MICROCAST IS THE LEADER

Eighteen years ago Austenal Laboratories originated the MICROCAST PROCESS for precision casting of intricate dental appliances to close tolerances using Vitallium*. In 1936, production on surgical appliances and jewelry specialties was pioneered by Austenal—another contribution by MICROCAST.

Another significant development was the application of the MICROCAST PROCESS to the production of turbo-supercharger blades which were produced by the millions during the war period.

This pioneering record of achievement is the reason why manufacturers are looking to Austenal and the MICROCAST PROCESS for the practical solution to intricate casting problems where close tolerances and high production are important. Perhaps this experience can help you, too.

INDUSTRIES NOW USING MICROCAST

Austenal is now producing quantity castings from a fraction of an ounce up to a pound for the following industries: Aircraft, Automotive, Bottle Cap, Business Machine, Dairy, Electrical, Hearing Aid, Heating, Phonograph, Photographic, Printing, Radio and Sewing Machine.

More complete information on MICROCAST is contained in a new booklet published by the Austenal Laboratories, Inc., originators of the MICROCAST PROCESS. This valuable new booklet is fully illustrated and describes many industrial applications for MICROCASTINGS as well as giving a step by step description of the process itself. Write for your copy today.

MICROCAST PRECISION CASTINGS PROCESS

MicroCast

AUSTENAL LABORATORIES, *INC.*

224 East 39th Street, New York 16, New York
5932 South Wentworth Ave., Chicago 21, Illinois

COPYRIGHT 1946 AUSTENAL LABORATORIES, INC.

SOCKET HEAD CAP SCREWS

UNBRAKO

Reg. U. S. Pat. Off.

Have these

OUTSTANDING ADVANTAGES

STRENGTH, TOUGHNESS, RELIABILITY AND PRECISION ACCURACY . . . the result of constant testing, inspection and careful quality control from the time the high tensile steel—made to "Unbrako" specifications—leaves the mill until it is a finished product ready for shipment to you; KNURLED HEAD FOR EASY ASSEMBLY . . . provides a slip- and fumble-proof grip—even with the oiliest fingers—and it can be screwed-in faster and farther before it becomes necessary to use a wrench; EASY START THREAD POINT . . . specially designed to assure fast, easy thread start; INTERNAL WRENCHING FEATURE . . . promotes Compact Designs which save space, material, weight, and costs. Write for your "Unbrako" catalog. **"Unbrako" and "Hallowell" products are sold entirely through distributors.**

PAT'D & PATS. PEND

PAT'D & PATS. PEND

KITS: PAT PENDING

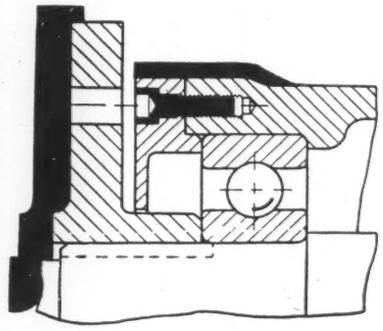
The "Unbrako" Socket Set Screw with the knurled cup point is a Self-Locker . . . the knurled point digs in and refuses to budge—regardless of the most chattering vibration. Yet, this screw can be backed-out and used over and over again.

The "Unbrako" Socket Set Screw with knurled threads is also a Self-Locker . . . and can be used where the point cannot be knurled. These and the Socket Head Cap Screws are available in sizes from #4 to 1½".

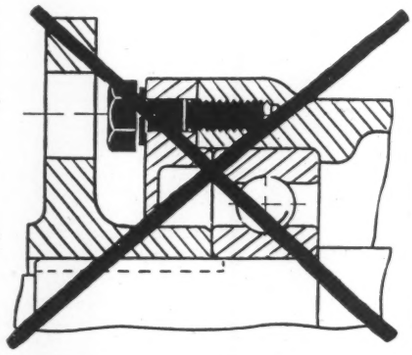
You can't screw socket screws in or out without a hex socket wrench—so why not get our No. 25 or No. 50 "Hallowell" Hollow Handle Key Kit which contains most all hex bits.

Knurling of Socket Screws originated with "Unbrako" in 1934.

This...



...Not This



OVER 43 YEARS IN BUSINESS

STANDARD PRESSED STEEL CO.

JENKINTOWN, PENNA., BOX 102

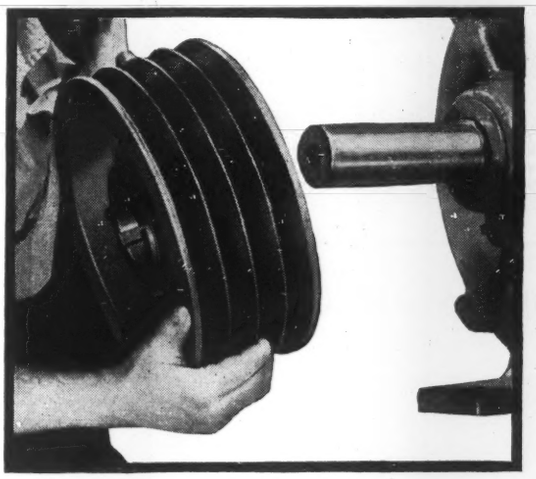
BOSTON · CHICAGO · DETROIT · INDIANAPOLIS · ST LOUIS · SAN FRANCISCO

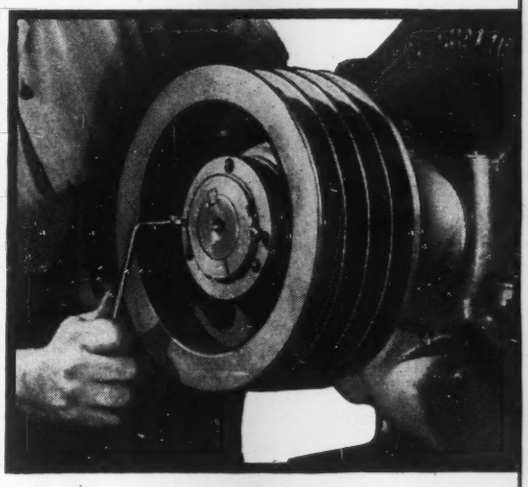
Wichita City Library

Easy-Mounting, Fast-Locking Sheave

Pays Off

The First Time You Put It On!





"MAGIC-GRIP" *sheaves offer time-saving, money-saving features!*

EVEN if you install the sheave only once, and never change it again — it pays to get "Magic Grip" sheaves! For frequent changes, naturally, your savings pyramid.

- **No filing or reaming.** "Magic-Grip" bushing slides easily, even on oversize shafts.
- **No hammering or forcing** to damage motor bearings.
- **No wheel puller needed to get the sheave off.**
- **No set screws** to mar or score the shaft.
- **No wobble or blacklash.** "Magic-Grip" sheaves lock to shaft with shrunk-on grip.

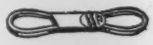
HOW DOES IT WORK? Sheave and bushing come completely assembled. You just slip it on the shaft — align — and tighten three screws. *That's all!* And it comes off just as easily.

Standardize on time-saving, money-saving "Magic-Grip" sheaves. They're heavy duty, precision made and finely finished — the best sheaves you can buy . . . the best economy in the long run. Get them through your nearest A-C dealer or office.

ALLIS-CHALMERS, MILWAUKEE 1, WIS.

A 2166

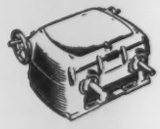
TEXROPE .. Greatest Name in V-Belt Drives



"Super 7" V-BELTS
Five Types — Sizes to suit every power transmission job.

Texsteel, Texdrive, "Magic-Grip"
— sheaves in a full range of sizes, grooves.

"Vari-Pitch" SHEAVES
Exact variations in speed, stationery or motion control.



SPEED CHANGERS
Speed variations up to 375% at the turn of a crank.

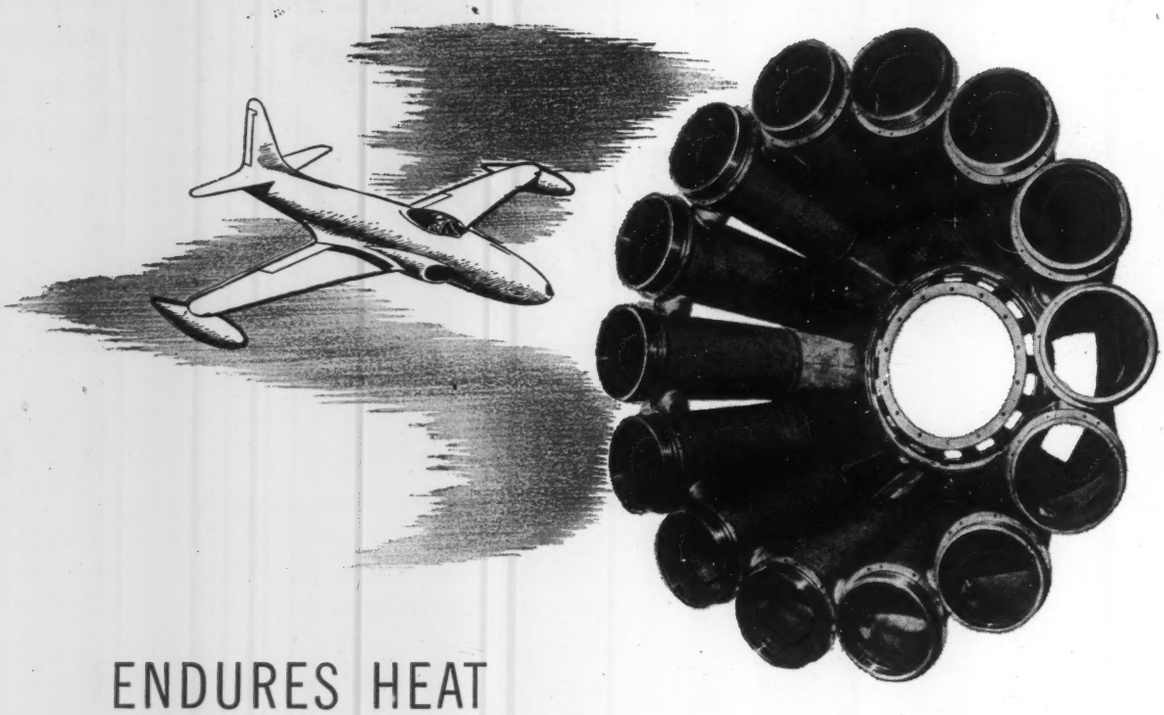
ENGINEERING
Finest V-Belt engineering talent in the world—at your call.

TEXROPE "Super 7" V-Belts result from the cooperative research of two great companies — Allis-Chalmers and B. F. Goodrich. They are sold only by A-C.

ALLIS-CHALMERS

One of the Big 3 in Electric Power Equipment — Biggest of All in Range of Industrial Products

1847 1947 A CENTURY OF SERVICE to Industry THAT MADE America Great



ENDURES HEAT

Burner for jet engines made of stainless steel

This assembly of 14 combustion chambers is part of a jet engine through which fiery gases flow at temperatures over 1,500 degrees Fahrenheit. To withstand these high temperatures, and also the corrosive attack of the combustion products, this entire burner unit and various accessory engine parts are constructed of stainless steel. This ideal combination of heat endurance and corrosion resistance makes stainless steel the best metal for countless other types of equipment too — ranging in size and shape from huge chemical reaction towers to frying pans for your kitchen stove.

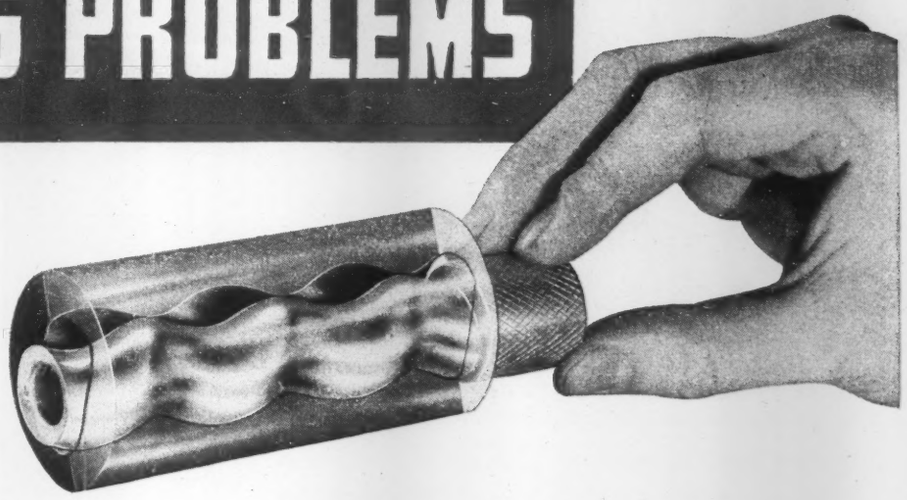
Ask to receive our monthly publication ELECTROMET REVIEW if you would like to keep informed of these various uses of stainless and other alloy steels. Or, if you need advice on their production, properties, and fabrication, consult our Technical Service Department. While we do not make alloy steels, or any other kind of steel, we do manufacture the ferro-alloys used in their production. Consequently, through years of research and engineering, we have acquired a fund of information that may be of benefit to you.

ELECTRO METALLURGICAL COMPANY
Unit of Union Carbide and Carbon Corporation
UCC
30 East 42nd Street, New York 17, N. Y.
In Canada: Electro Metallurgical Company of Canada, Limited, Welland, Ontario

STAINLESS STEEL

BEAUTIFUL ENDURING STRONG TOUGH

LICKS PUMPING PROBLEMS



Pumps Practically *Anything* from Liquids to Non-Pourable Pastes

If it will push through a pipe, you can *move* it with an R & M Moyno—the amazing helical-rotor pump that passes particles, resists chemical reaction, delivers positive pressure without pulsation...*stands up* where other pumps *fail.* From clay slip to corn syrup, from gasoline to glue, here's the *answer* to your pumping problems.

"Like a rope flipped up and down in a long slot," said one Plant Engineer describing unique Moyno rotary motion. Rotor and stator work together to form *ever-changing,* progressing seal lines with voids between which carry the material. Reversing rotation reverses flow. *Thousands* are in use on all types of services.

Typical Materials Handled

Anhydrous Ammonia	Gasoline	Plastics
Animal Blood	Glucose	Porcelain
Beer	Glue, Water Glass	Pulp (fruit and vegetable)
Brewer's Yeast	Greases	Putty
Carbide Sludge	Hash	Resins, hot
Cellulose Solutions	Liquefied Gases	Rubber Cement
Chemicals	Tool Coolant	Sand, Silt
Citrus Juices	Magnesium	Sludge, Slurries
Clay Slip	Marshmallow	Solvents
Cold Cream	Milk, Cream	Starches
Corn Syrup	Molasses	Tar
Distiller's Slop	Mud (oil well)	Tooth Paste
Dog Food	Oils	Water (sweet, salt)
Enamel	Paper Stock and Coatings	Wine (including stems, seeds, sediments)
Fuel Oil	Paints	

The Pump Without "Type" Limitations

MOYNO vs. Piston Pump

Moynos have no valves; no pulsation; less weight, bulk; better performance on highly viscous fluids; much longer life on abrasives; usually, lower cost.

MOYNO vs. Centrifugal

Moynos are self-priming; liquid velocities are low, smooth, uniform; displacement is positive. Moynos give better capacity-pressure regulation; can create higher reserve pressures; pump highly viscous fluids better, and with less wear.

MOYNO vs. Rotary

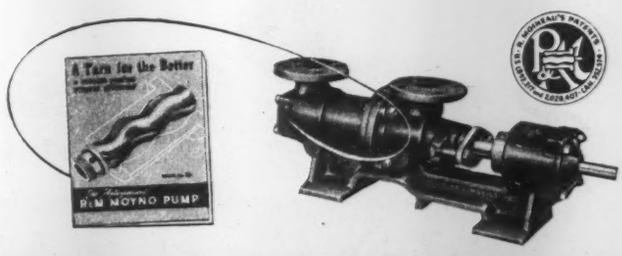
Moynos are not limited to moderate pressures and to services only mildly abrasive; do not depend upon critical end-sealing and large areas of diametrical clearance. Moyno sealing is all in one replaceable element with a minimum of constantly changing diametric seal, and no end-seal whatever.

MOYNO vs. Turbine

Moynos pump virtually anything; have no high-speed impellers or critical clearances; handle abrasives.

Find Out About Moyno Pumps, NOW!

If you use pumps, or ever expect to, you should know about the R & M Moyno. It's the *one* pump that "does everything" well. Types for general service; for higher pressures (up to 1000 p.s.i.); for liquefied gases; for food-type products; and for specialized service needs. Our new book, "A Turn for the Better . . .," tells the whole interesting story. Write today. Distributors from coast to coast.



ROBBINS & MYERS • INC. MOYNO PUMP DIVISION • SPRINGFIELD, OHIO
In Canada: Robbins & Myers Co. of Canada, Ltd., Brantford, Ont.

MOTORS · HOISTS · CRANES · MACHINE DRIVES · FANS · MOYNO PUMPS · FOUNDED 1878

the science of FLEXONICS as advanced by CHICAGO METAL HOSE CORPORATION

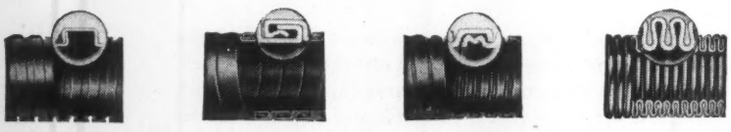
Photograph by courtesy of Standard Oil Company of California.

the science of FLEXONICS ..."the controlled bending of thin metals for use under varying conditions of temperature, pressure, vibration and corrosion"—is exemplified in the basic products of Chicago Metal Hose Corporation.

• Rex-Weld, Rex-Tube and Rex-Flex are *branded* flexible metal hose. Each of these—as well as C.M.H. Stainless Steel Bellows, Compensators and allied products—is manufactured with the increased product knowledge which the Science of Flexonics makes possible.

Chicago Metal Hose Corporation continues to devote its energies to this science. Just as C.M.H. has developed new *basic* products in the past, so it continues that development. These accomplishments—and this continued progress—have resulted in recognition of Chicago Metal Hose as the leader in the design and manufacture of flexible metal hose and allied products. For product application guidance, C.M.H. has data available—derived from the Science of Flexonics. Chicago Metal Hose Corporation welcomes the opportunity of putting its knowledge of this science to work for you.

"FLEXON" *identifies C. M. H. products, which have served industry for more than 44 years.*



CMH CHICAGO METAL HOSE CORPORATION

Maywood, Illinois • Plants: Maywood and Elgin, Illinois

How long will it be before exploration of stellar spaces becomes practical? Ten years—fifty years—a hundred years? It is not wise to predict, particularly when we consider the advances that the past few years have brought.

But if you are developing a rocket ship, you will undoubtedly call on Foote Bros.—just as in the past manufacturers of other marvels of transportation have.

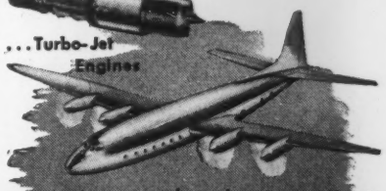
Today, Foote Bros. is producing precision gears of Aircraft Quality for many purposes where light weight, extremely high speeds, maximum efficiency, compactness and low noise level are important. Foote Bros. Power Units and Actuators provide absolute control from a remote point. These units assure accurate mounting so essential if the full benefit of "A-Q" Gears is to be realized.

Regardless of what your requirements in power transmission may be, Foote Bros.' two large plants are ready to serve you. The Precision Gear Division has complete facilities for producing "A-Q" Gears and Power Units in quantities. The Industrial Gear Division is equipped to turn out giant gears up to 20 feet in diameter or production runs of smaller gears. This division also manufactures speed reducers in sizes and ratios to meet almost every industrial need

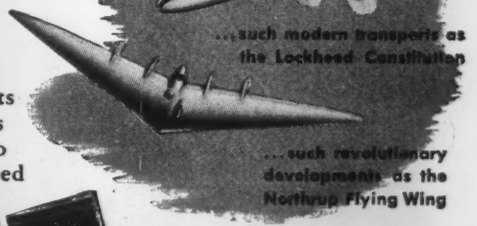
FOOTE BROS. PRODUCTS ARE USED IN MANY OF THE LATEST AIRCRAFT DEVELOPMENTS

...Pratt & Whitney Wasp Major Engine

...Turbo-Jet Engines



...such modern transports as the Lockheed Constitution



...such revolutionary developments as the Northrup Flying Wing

FOOTE BROS. GEAR AND MACHINE CORPORATION
DEPARTMENT O, 4545 S. WESTERN BOULEVARD, CHICAGO 9, ILL.

A recent bulletin on Power Units gives complete engineering data on "packages of power." Sent on request. Also available, a bulletin on Aircraft Quality Gears. Mail coupon.

FOOTE BROS.

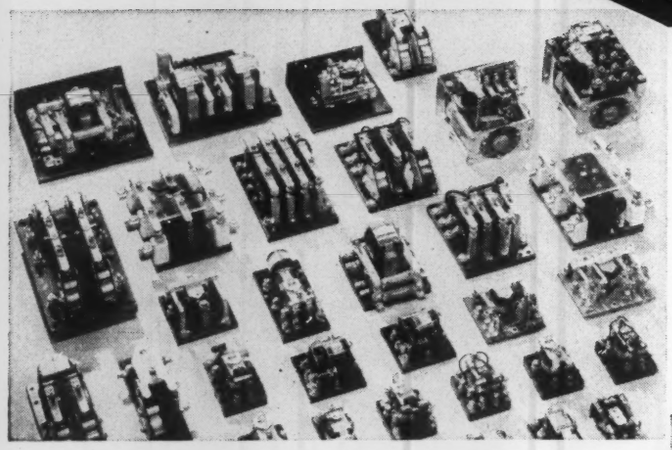
Better Power Transmission Through Better Gears

Foote Bros. Gear and Machine Corporation
Dept. O, 4545 S. Western Boulevard, Chicago 9, Illinois
Please send me Bulletins on: ☐ Power Units ☐ Aircraft Quality Gears.

Name.....*Position*.....
Firm.....
Address.....
City.....*State*.....

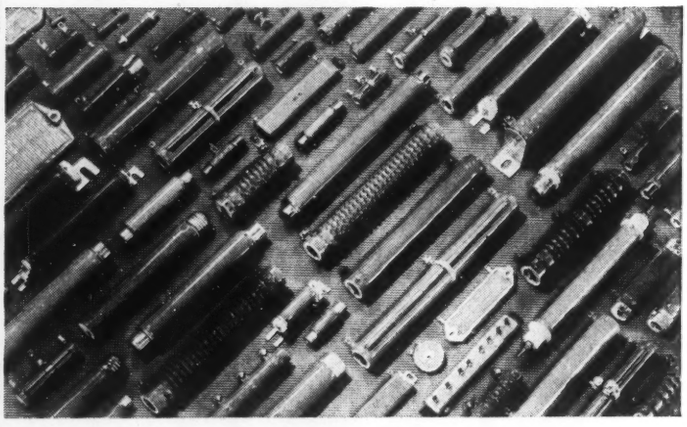
RELY ON THE LINE WITH THE RANGE THAT'S WIDE

You can find practically anything you want—in relays, resistors and rheostats—by selecting from the regular Ward Leonard line.



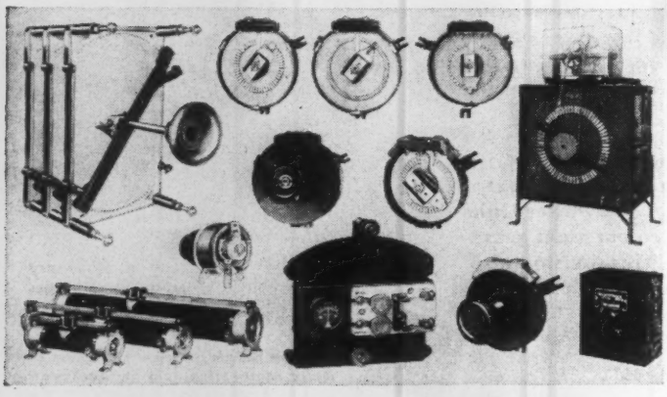
RELAYS

Crisp action, Durable construction. Low power consumption. Light, intermediate and heavy-duty types for sensitive, transfer, time delay, antenna change-over, break-in, and latch-in operation. *(Illustration at left)*



RESISTORS

Withstand heat, moisture, vibration, and other adverse operating conditions. Regular line includes wide range of types, sizes, ratings, terminals, mountings and enclosures. *(Illustration at right)*



RHEOSTATS

Operate smoothly. Durable contacts. Line includes widest range of sizes, tapers, and current ratings from tiny ring-types for radio to huge multiple assemblies for heaviest industrial use. *(Illustration at left)*

WARD LEONARD

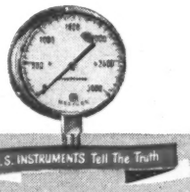
Electric Control Devices since 1892

WARD LEONARD ELECTRIC COMPANY • 58 SOUTH ST. • MOUNT VERNON, NEW YORK

An Instrument of Tomorrow

BETTER INSIDE ... BETTER OUTSIDE ... BETTER ON THE FACE OF IT

.... Here Today



UNITED STATES GAUGE

THE NEW USG SUPERGAUGE—is built for the consistent, accurate, dependable, long-time service that has made US Instruments the choice of more than 6 out of 10 original equipment manufacturers. Designed to withstand pulsation and vibration and to indicate with highest precision, Supergauge gives you a safe, positive check on process control. You also will find that Supergauge is the most modern, dependable and economical pressure measuring instrument that you can buy.

DIVISION OF AMERICAN MACHINE AND METALS, INC. SELLERSVILLE, PA.
Manufacturers of Pressure, Temperature, Flow and Electrical Measuring Instruments

USG

DC

DOW CORNING

SILICONES

VARNISHES
RESINS
FLUIDS
GREASES
SILASTIC*

withstand heat
exclude moisture
resist oxidation

SILICONE INSULATION

extends life of water cooled field coils

in electro-magnetic brakes

DC Silicones specified again in a better solution to a basic engineering problem.

Variable and controllable braking without use of friction or wearing parts has been achieved by the Dynamatic Corporation of Kenosha, Wisconsin. Applied to well drilling, electro-magnetic braking is accomplished through rotating an iron drum through a stationary magnetic field. The energy required to generate eddy currents in the rotating drum exerts a torque on the rotor proportional to the strength of the field and ranging up to 5000 h.p.

Service life of electro-magnetic brake is limited only by life of the field coils which operate at 250°F. and are cooled by circulating water. That's why Dow Corning Silicone Insulation was specified. None of these coils impregnated with DC 996 has failed. Insulation resistance remains high even after long exposure to weathering while the rig stands idle; rises rapidly to infinity when drilling is resumed. Use of DC 996 is described in leaflet No. B 3-4.

DOW CORNING CORPORATION · MIDLAND, MICHIGAN

Chicago Office: Builders' Building
Los Angeles Office: 634 S. Spring Street
In Canada: Fiberglas Canada, Ltd., Toronto
Cleveland Office: Terminal Tower
New York Office: Empire State Building
In England: Albright and Wilson, Ltd., London

*TRADE MARK, DOW CORNING CORPORATION

Dow Corning

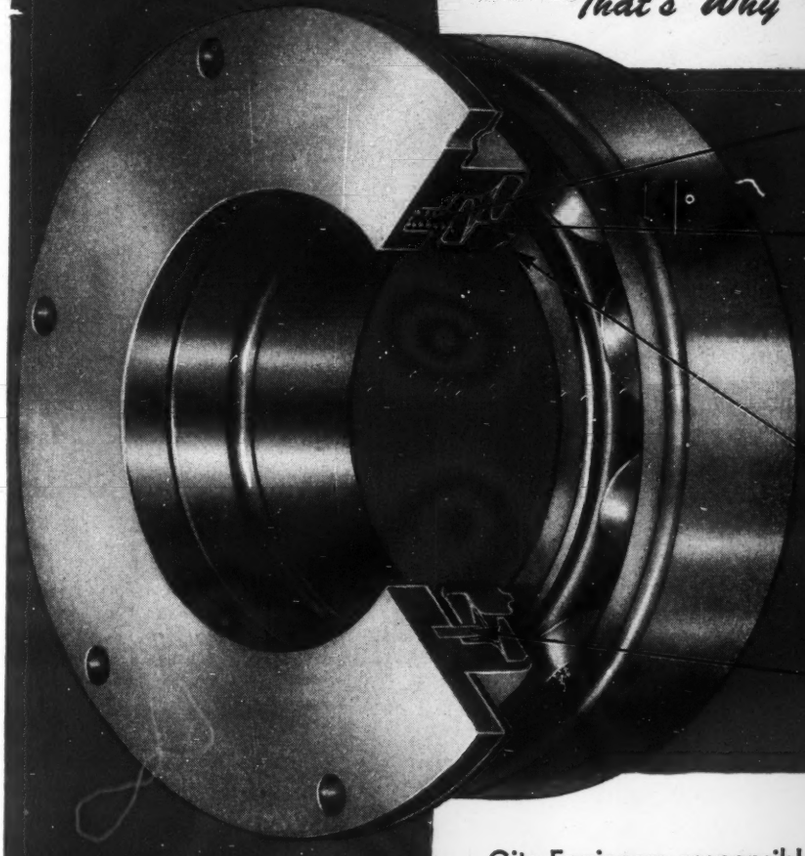
FIRST IN SILICONES

Equal to your most intricate needs

GITS
HIGH SPEED OIL SEALS

—represent over 35 years of specialty engineering

That's Why They Always Satisfy



SPRINGS
give proper, evenly distributed pressure on bronze seal ring.

DIAPHRAGM
made of special oilproof and waterproof fabric, resisting heat up to 220° F. constant and 275° F. intermittent. These seals are made also with a metal diaphragm and are used where temperatures are constant above 220° F.

SEALS HERE
Oil is sealed in the bearing chamber by a bronze ring pressing against a bearing race or a hardened and lapped washer. This surface must be lapped free of all scratches and markings.

GUIDE PINS
eliminate torsional strain on diaphragm.

Gits Engineers responsible for the design and function of this world-accepted high speed seal have worked with it and slept with it until they have perfected its development to the finest degree of oil-sealing efficiency possible. In this tried and proved seal, you have a highly-finished and specially-tensioned bronze contact face that operates on a true-running, very hard steel surface lapped to seal oil within a bearing chamber. *This seal does not contact the periphery of the shaft.* Available in ¼" to 4" shaft diameters—larger on application. Permit us to help you on your next sealing problem. Submit complete data for our recommendations.

For detailed information on this and others of the famous Gits line of lubricating devices, write for Bulletin.

GITS BROS. MFG. CO.
1868 S. Kilbourn Avenue, Chicago 23, Illinois
Exclusive for over 35 years

CAN A SIMPLE THING . . . . . LIKE A BETTER SPRING . . . . . .

help your sales?

SPRINGS
SMALL STAMPINGS
WIRE FORMS

SPRING STEEL

TODAY there's *new life* to spring performance. More uses for metals, refinements in heat-treating, improvements in production methods—all add up to better operation, greater dependability. Each of these factors influences consumer acceptance, whether it's a machine tool, office or home appliance, or pleasure vehicle.

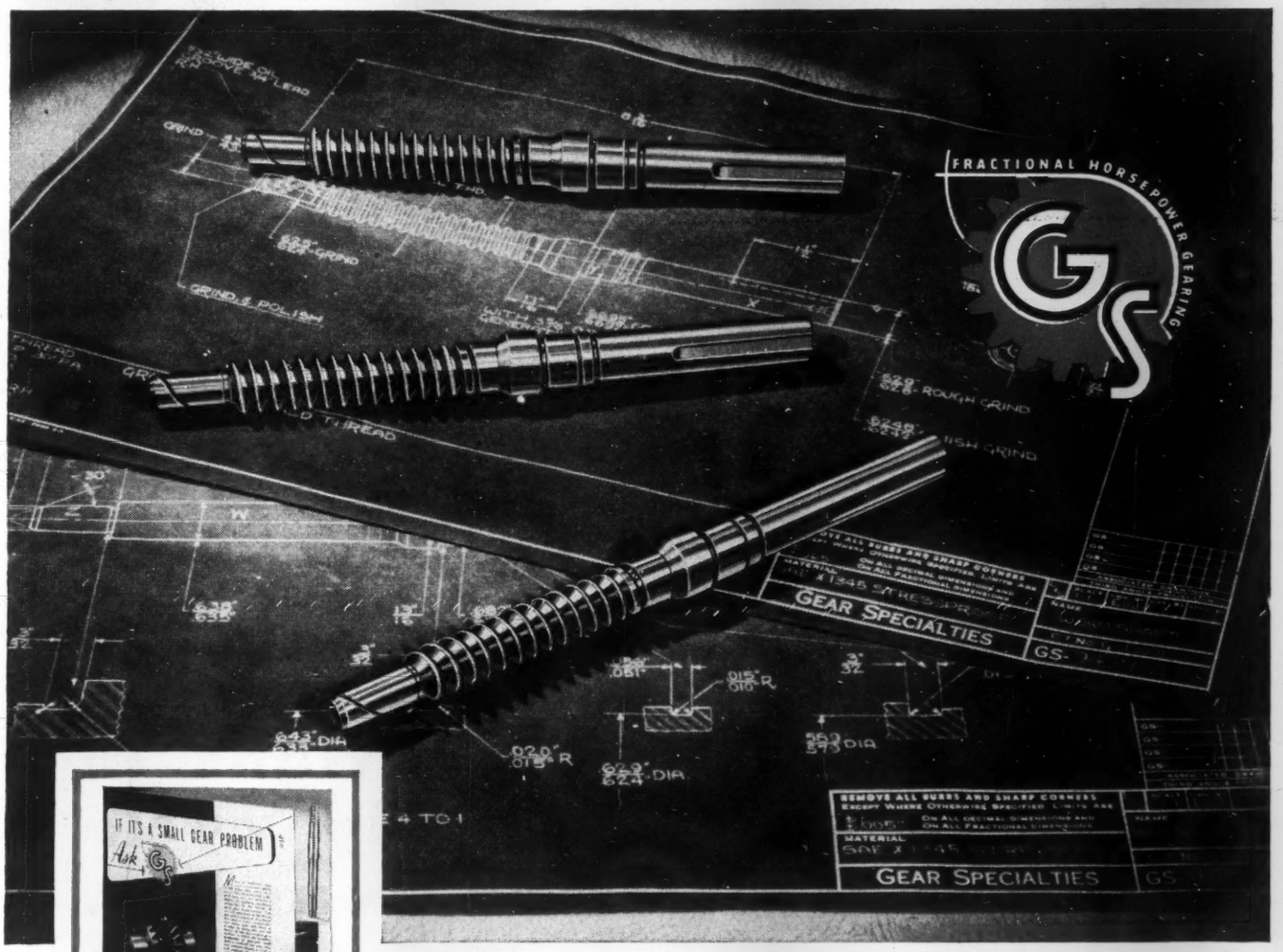
Sometimes, just a penny's-worth means the difference between good-enough and better springs. So safeguard user satisfaction—let Barnes engineers give your springs up-to-date analysis. They are alert to your needs, looking ahead to improved mechanical performance, a better product for more sales.

Barnes-made springs

Engineered Pep and Power

WALLACE BARNES COMPANY
Division of Associated Spring Corporation
Bristol Connecticut

HOW CLOSE MUST THE TOLERANCES BE?



The G.S. Catalog Bulletin describes many different types and applications of G.S. Small Gears. Please ask for a copy on company stationery. There's no cost or obligation.

IF *extreme* precision is a factor in the small gears you need, better let "G.S." do the job. For, here, men, materials and machinery are coordinated to the intensively specialized operation of manufacturing FRACTIONAL HORSEPOWER GEARS *exclusively.* G.S. Gears from 12 to 96 D.P. are produced in volume with *remarkable uniformity.* Take advantage of this unusual Small Gear service, developed to its present high degree of efficiency thru a quarter century of experience with all different types and materials. G.S. engineers will gladly lend you every possible aid. Ask them today for suggestions, ideas and cost estimates.

GEAR Specialties

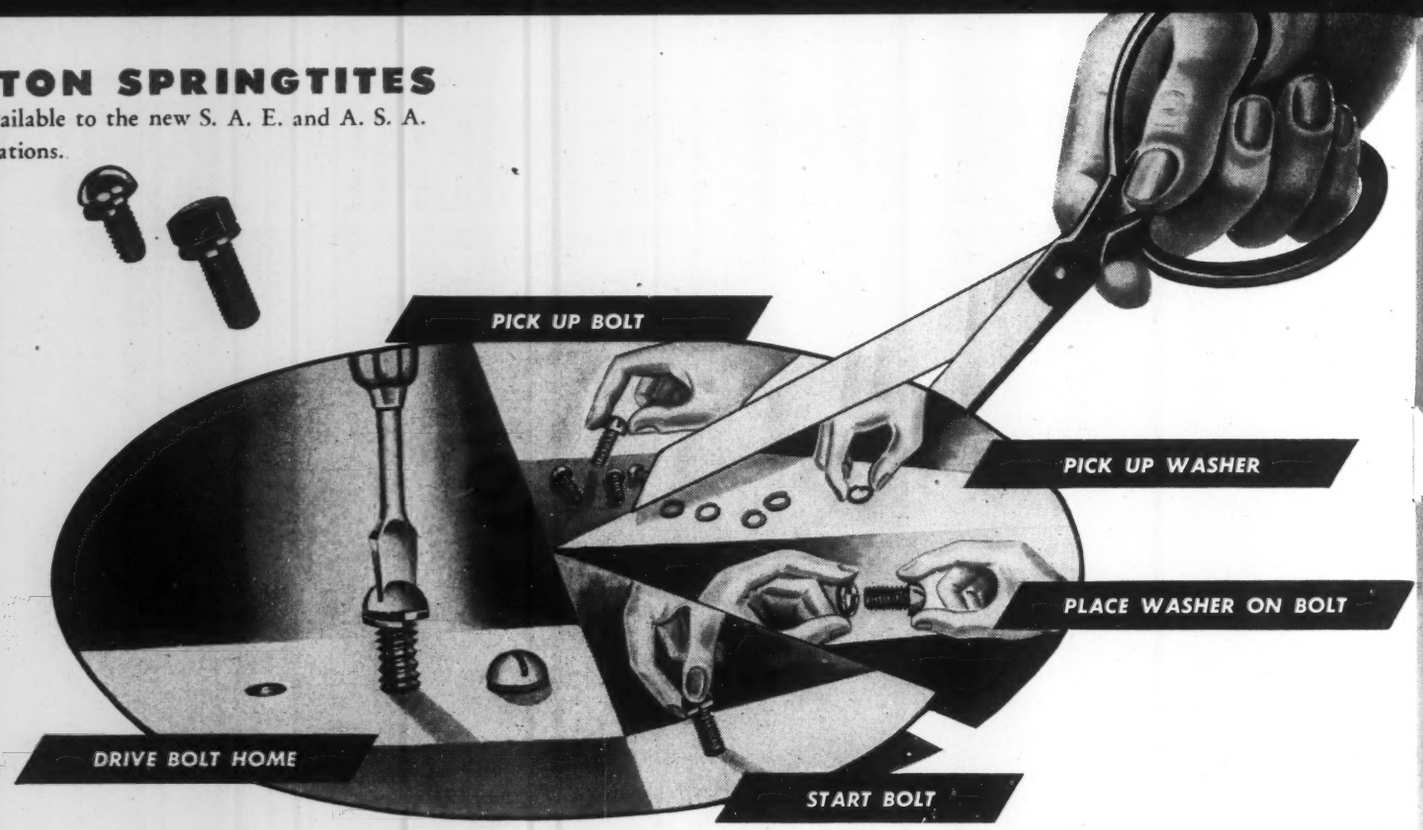
Spurs • Spirals • Helicals • Bevels • Internals • Worm Gearing • Racks • Thread Grinding

2635 WEST MEDILL AVENUE • CHICAGO 47, ILLINOIS

MEMBER OF AGMA

WORLD'S LARGEST EXCLUSIVE MANUFACTURERS OF FRACTIONAL HORSEPOWER GEARS

EATON SPRINGTITES
now available to the new S. A. E. and A. S. A. specifications.



Cutting needless, costly operations in your assembly cycle is common sense . . .

EATON SPRINGTITES are Reliance-quality spring lock washers made to the new approved ASME standards, pre-assembled on bolts or screws so they can't come off.

Used wherever bolts or screws are employed on your assembly line, they give your product all the advantages of spring lock washer assembly and

— cut out time-consuming operations of picking up lock washers and assembling them on bolts or screws.

— eliminate losses — help to balance inventory and insure the use of a correctly engineered spring lock washer.

— eliminate "fumbling" — facilitate assembly in awkward, hard-to-get-at places.

— assure the satisfactory performance of bolted fastenings on your product.

Eaton Springtites can be furnished in bolt or screw sizes to Society of Automotive Engineers and American Standards Association specifications.

You'll find many helpful hints and cost-cutting suggestions in the Eaton Springtites folder. Write for your copy.

RELIANCE SPRING LOCK WASHERS in American Standard sizes — compensate for looseness of bolted parts resulting from dimensional changes — keep assemblies tighter longer.

RELIANCE SNAP RINGS Snap, bearing, lock retainer rings used on shafts, in counter bores, and on outer races of bearings. Cut production cost — save time and material. Write for Folder 43.

Reliance Division

EATON
EATON MANUFACTURING COMPANY

OFFICES AND PLANT **MASSILLON, OHIO**

Sales Offices: New York • Cleveland • Detroit • Chicago • St. Louis • San Francisco • Montreal

JOBS WANTED FOR THIS WAR VETERAN

POSITION-INDICATING EQUIPMENT

FOR ACCURATE AND RELIABLE INDICATION FROM REMOTE STATIONS

YOUR DESIGN ENGINEER WILL BE INTERESTED IN THESE SELSYN FEATURES

- Simplicity of design and of construction
- Freedom from temperature, position, and voltage errors
- Light weight
- Operation from 24-volt power supply
- Compactness
- Low power consumption
- Interchangeable elements
- Parallel operation
- Low maintenance costs
- No hairsprings used
- No lubrication required
- Radio and magnetic shielding
- Long life
- Power-failure indication
- Variety of designs

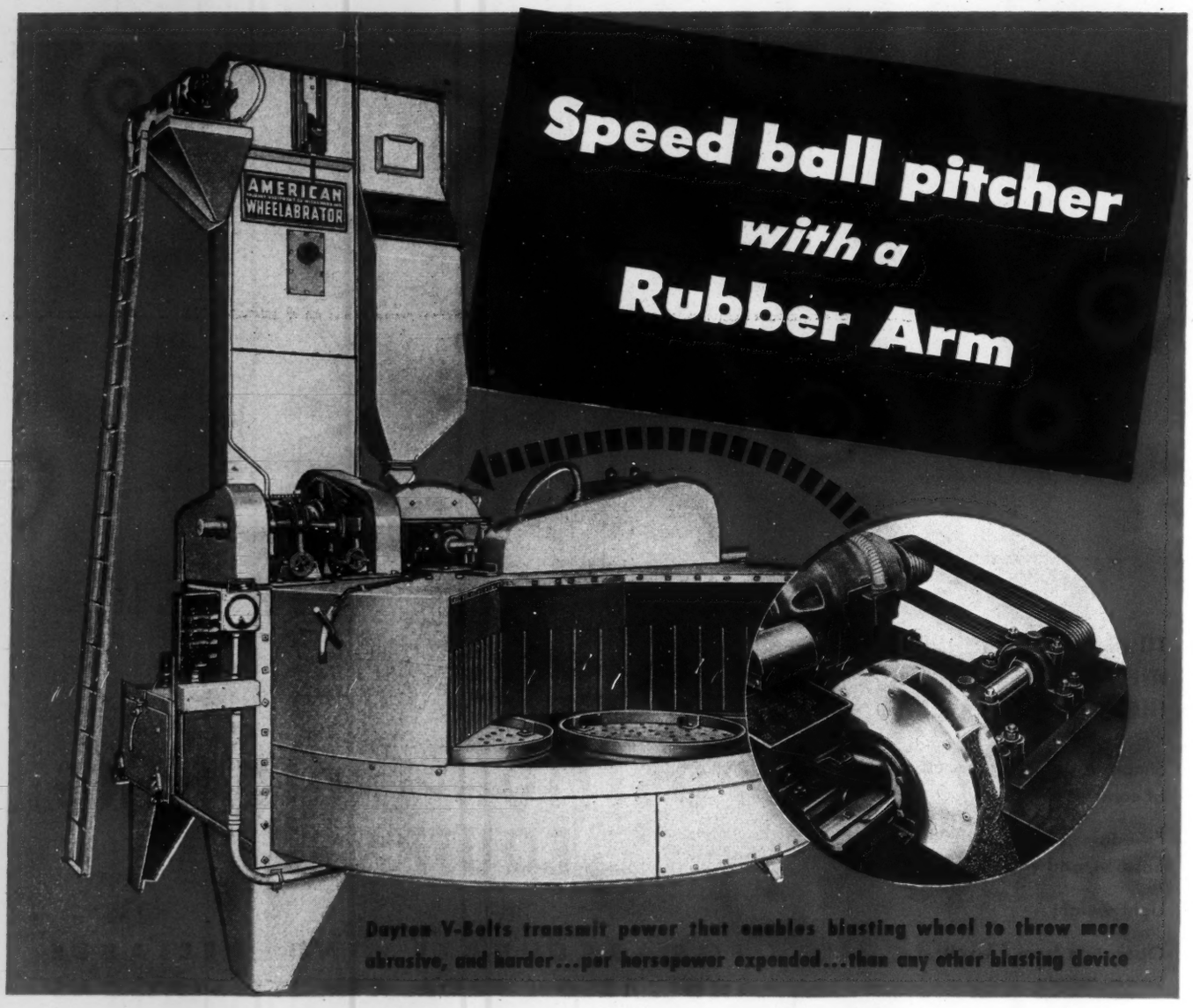
Initially designed for installation in military aircraft, d-c selsyn instruments are proving to be extremely adaptable to a wide variety of industrial uses. Your design men may find that this equipment is the solution to their problems of remote-station indication.

So that we may be of further service to design engineers, we have just completed an application manual to assist in the selection and use of position-indicating equipment. The three-wire, three-coil system is presented in this manual to the exclusion of the numerous other d-c selsyn systems that have been devised and are available for special purposes. It is the most versatile system and, therefore, the most widely used for general position-indicating applications.

Let our engineers help you with any unusual applications that require special consideration; and for your own free copy of our d-c selsyn position-indicating equipment manual, GET-1304, call your nearest G-E sales office or write to Apparatus Dept., Section A607-12, General Electric Company, Schenectady 5, N. Y.

GENERAL ELECTRIC

607-12



The need for transmitting great horsepower in a small space was the problem facing the industrial designer of an abrasive blaster. And a Dayton V-Belt Drive solved it.

This is another outstanding example of the flexibility of Dayton V-Belt Drives. And the ability of Dayton V-Belts to perform in excess of standard requirements under all operating conditions . . . unaffected by dust, oil, heat, liquids . . . is another of the many reasons why more industrial designers consistently specify Daytons for original equipment.

A Dayton Power Transmission Specialist is ready to help you. Call or write: THE DAYTON RUBBER MANUFACTURING CO., DAYTON 1, OHIO.

TWO CATALOG MUSTS FOR INDUSTRIAL DESIGNERS

Catalog No. 280—a 384-page encyclopedia of V-Belt information listing millions of power drive combinations.

* *

Catalog No. 150—contains complete information on fractional horsepower drives.

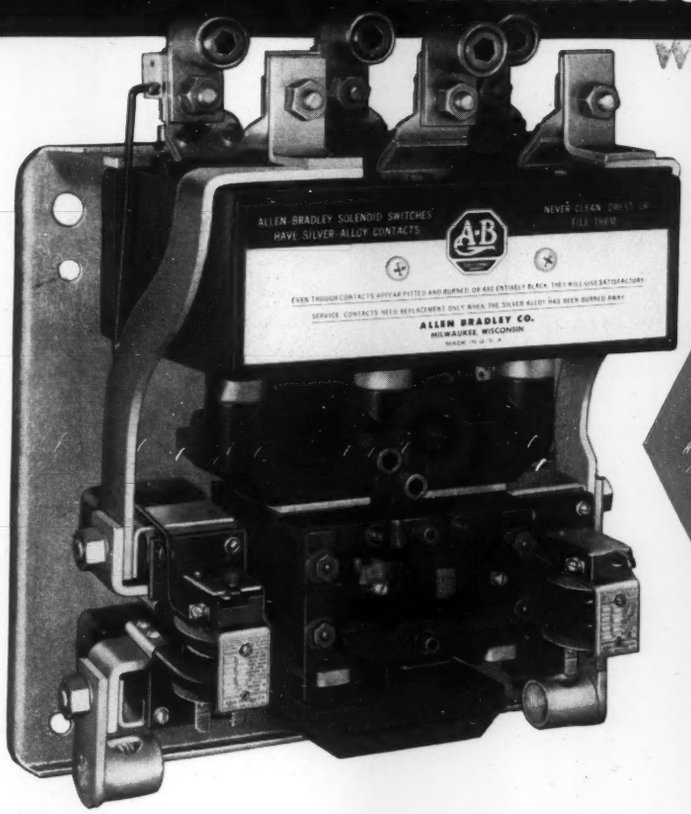
Dayton Rubber

THE MARK OF TECHNICAL EXCELLENCE IN NATURAL AND SYNTHETIC RUBBER

THE WORLD'S LARGEST MANUFACTURER OF V-BELTS

ON TEST. 5,721,098 OPERATIONS before failure!

Wichita City Library



NEW SIZE 5 Bulletin 709 SOLENOID STARTER Shows Amazing Ruggedness in Life Tests

Now . . . Solenoid Construction . . . with all its Advantages . . . in a 300-Ampere Starter

In actual mechanical life test, the new Allen-Bradley Size 5 solenoid starter operated 5,721,098 times before a minor failure occurred. This amazing test proves the inherent ruggedness and long life of this new solenoid starter—a life span heretofore unheard of in a 300-ampere starter!

The New Size 5 solenoid starter has all the proved advantages of Allen-Bradley solenoid design—simple construction . . . maintenance-free, double break, silver alloy contacts . . . compact, self-contained switch mechanism This starter will bring you the same astounding results in a 300-ampere switch as you have been enjoying in Allen-Bradley solenoid starters of smaller capacity. Therefore, for your large motors, specify this new solenoid starter.

Bulletin 709, Size 5 solenoid starter in its attractive, NEMA Type 1, sheet metal enclosure with white interior.

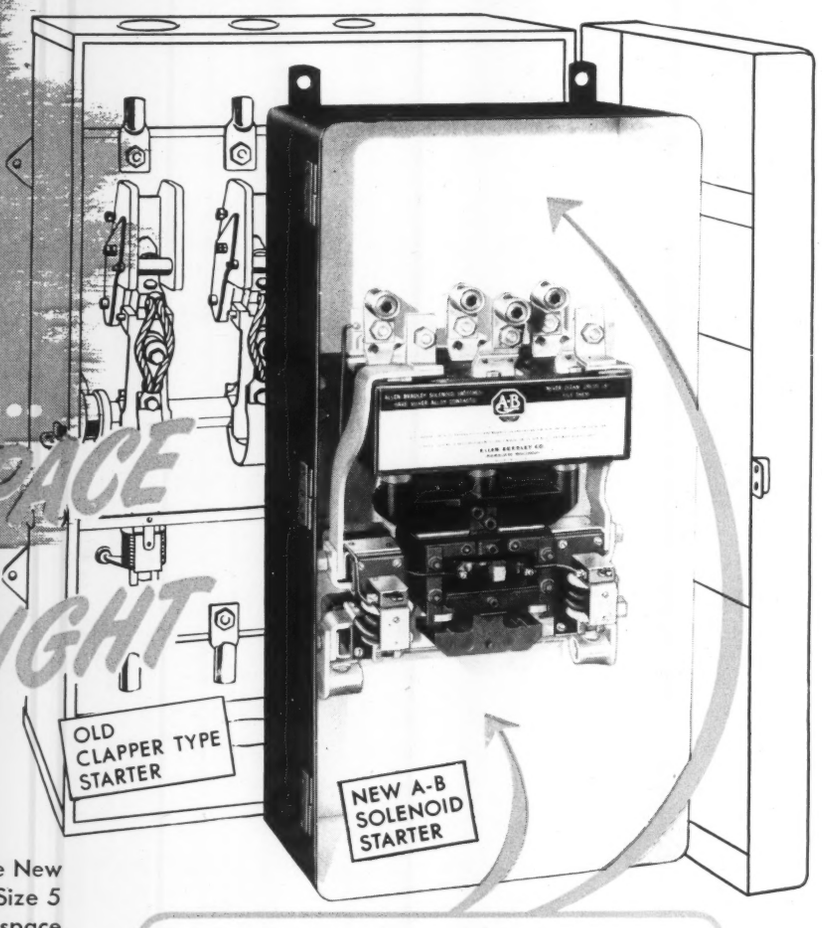
A-B Quality

ALLEN-BRADLEY
SOLENOID MOTOR CONTROL

QUALITY

NEW SIZE 5
Bulletin 709 SOLENOID STARTER takes...

46% LESS SPACE
50% LESS WEIGHT



Put a conventional clapper type starter up against the New Size 5 solenoid starter. Notice the difference! The New Size 5 is much smaller and lighter. Yet it provides much more space for wiring, and will outperform the clapper starter. It is more rugged and reliable . . . has a greater current interrupting capacity . . . is easier to install . . . is practically maintenance-free. Each pole of the New Size 5 solenoid starter is enclosed in an individual arc chamber which confines the arc and prevents flashover. This new unit will easily interrupt ten times its maximum horsepower rating. Following are a few of its other advantages:

UNIT CONSTRUCTION

All parts are assembled on a steel base plate and insulated from it. The starter can be mounted as a unit directly on any metal surface without extra insulation. All terminals are readily accessible from the front.

NO CONTACT MAINTENANCE

Patented double break, silver alloy contacts are used. Oxides that may form on these contacts are good electrical conductors. Hence, they never require filing or dressing, and valuable contact life is not wasted.

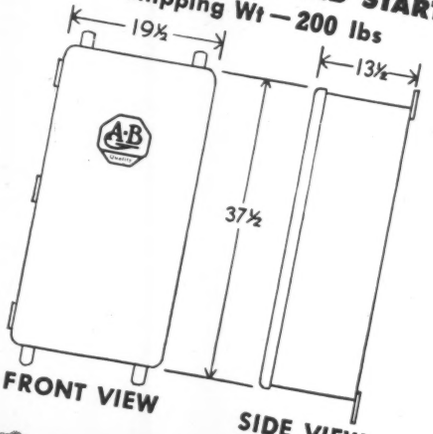
ONLY ONE MOVING PART

The only moving part in this starter is the solenoid plunger which moves up and down in a phosphor bronze guide, practically without friction. There are no pins, pivots, or hinges to corrode or gum up. No flexible jumpers to cause trouble or delay switch action.

Allen-Bradley Company
1316 S. Second St., Milwaukee 4, Wisconsin

LARGER SPACE FOR WIRING, TOO

NEW SIZE 5 SOLENOID STARTER
Shipping Wt — 200 lbs



A-B Quality

ALLEN-BRADLEY
SOLENOID MOTOR CONTROL

. . . with New A.C. Across-the-Line Magnetic Motor Starter

One button both starts *and* stops. Visual signal (operated mechanically) gives *positive* indication whether motor is ON or OFF.

These exclusive Master developments are just two of many that make this starter an outstanding engineering achievement. Chief among other features are clean, open design that makes the starter easy to wire; quick access to overload heaters and contacts from the front; sturdy straps (instead of flexible wire) as jumpers from overload relays to stationary contacts for extra rigidity to the entire assembly.

The start-stop single-button control feature with indicator flag is obtainable either integral with the starter or in a remote control station. Where multiple remote control of a single starter is required, the conventional two-button control can be furnished. For complete information on this new starter, simply write for Master Industrial Controls Bulletin No. 200, or get in touch with the nearest Master representative.

THE MASTER ELECTRIC COMPANY, DAYTON 1, OHIO

This new starter bears a trademark long famous on motors, assuring product integrity in control equipment as well.

MASTER

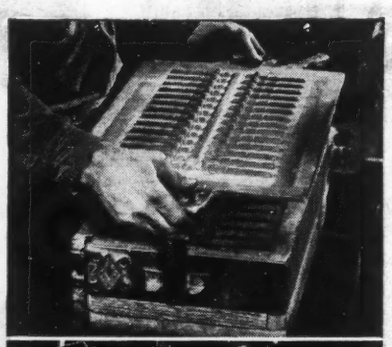
LABOR SAVING ON YOUR MIND?

DESIGN FOR A *BONUS* IN LIGHTNESS!

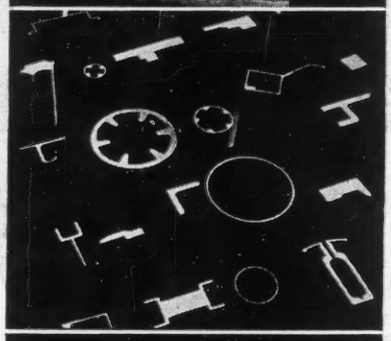
In products that have to be lifted, moved, handled, you're designing for readier sale when you specify American Magnesium. 35% lighter than aluminum, *75% lighter than steel,* it gives you production savings, too. Complex, high-cost assembly operations may be simplified by using castings, forgings, stampings or extrusions in this strong, feather-light metal. It machines easily, at high speeds . . . can be readily welded.

How to design? You may draw freely upon the light metal know-how—the 59 years' experience of Aluminum Company of America. Not only for design and production help, but for our knowledge of the *economics* of light metals that will help you use magnesium where it should be used.

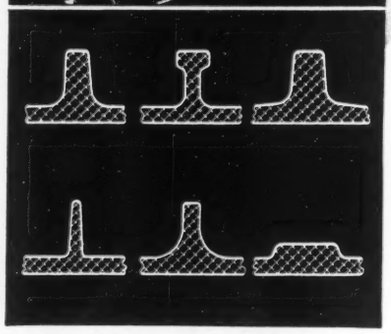
Take your first step toward a bonus in lightness today. Write, requesting the type of information you need, or call your nearest Alcoa Sales office. ALUMINUM COMPANY OF AMERICA, Sales agent for American Magnesium Products, 1703 Gulf Building, Pittsburgh 19, Penna.



LABOR SAVED when molders lift match plates of American Magnesium. Keeps core box, jig and fixture weights within legal limits for women workers.



INTRICATE SHAPES like these extrusions of American Magnesium save assembly costs. Die costs are low; strength and performance are assured by design know-how.

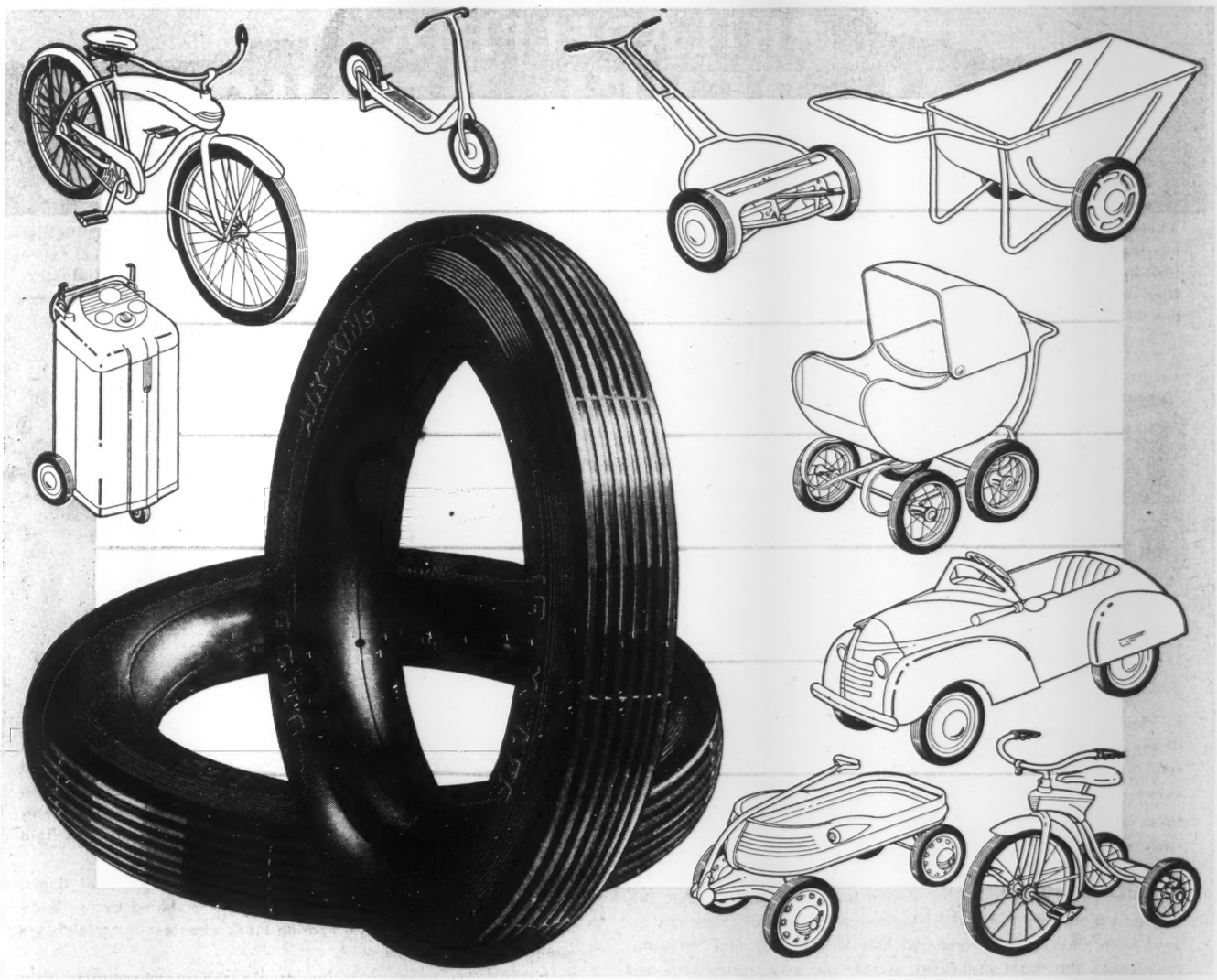


DESIGNING with American Magnesium offers no radical problems. The addition of a boss or fillet, or slight extra thickness, is more than made up for by feather-lightness, production economies.

MAGNESIUM MAZLO Reg. U.S. Pat. Off. PRODUCTS

AMERICAN MAGNESIUM CORPORATION

SUBSIDIARY OF ALUMINUM COMPANY OF AMERICA



AIR KING TIRES *Engineered*... not just made

AIR KING TIRES are another example of team-work between ***Research, Engineering,*** and ***Manufacturing*** as applied by The Ohio Rubber Company to specific problems of an industry.

For years, manufacturers of juvenile vehicles, bicycles, lawn mowers, wheelbarrows, hand trucks, portable battery chargers, paint sprayers, and numerous other types of portable, rolling units, equipped their wheeled products with either pneumatic or solid rubber tires. Each type of tire has its advantages and disadvantages on practically every application.

ORCO RESEARCH surveyed the entire, complex problem. ORCO ENGINEERS analyzed the facts and developed new standards of design and construction. ORCO MANUFACTURING established ***standardized*** production operations.

The end result is the **AIR KING** . . . the semi-pneumatic CUSHION tire that combines the advantages of pneumatic and solid rubber tires with none of their disadvantages.

To insure uniformity of quality standards, **AIR KING TIRES** are subjected to "breakdown" tests for load, speed, and wear. As a final check, each **AIR KING TIRE** is tested before release for shipment. Products equipped with **AIR KINGS** offer "quality conscious" users top value through better, longer-lasting, trouble-free performance.

When YOU have a "problem in rubber" . . . ***CALL ORCO.***

ORCO rubber products

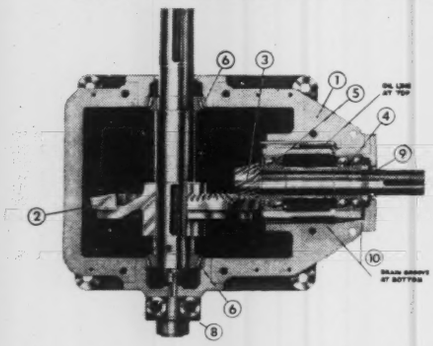
OHIO RUBBER CO

THE OHIO RUBBER COMPANY · WILLOUGHBY, OHIO · LONG BEACH, CAL

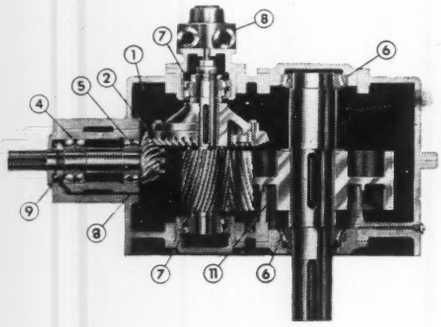
Branch Offices: DETROIT • NEW YORK • CHICAGO • INDIANAPOLIS • CLEVELAND • BOSTON

PHILADELPHIA
SPIRAL BEVEL REDUCERS
GIVE VERY HIGH EFFICIENCIES

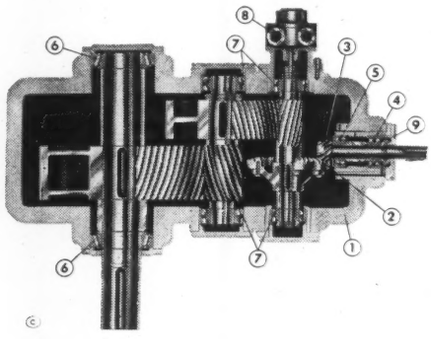
These Units have the same *High Efficiencies* as parallel shaft herringbone reducers.—and they require no "cooling system" to keep their operating temperatures within safe limits. In fact, they may often be used where a Worm Gear Reducer would not be recommended. They are available in Single, Double or Triple Reductions, and may be had to take care of reduction ratios from 1 to 1, up to 238 to 1. Horizontal or Vertical types are available to meet the various requirements of Industry. Note and compare the "special design features" shown and explained below.



Sectional view of Single Horizontal Unit
Type 3400 BT



Sectional view of Double Vertical Unit
Type 3500 VBH



Sectional view of Triple Horizontal Unit
Type 3600 BLT

1. Housings are of close grained cast iron. Points of stress are well ribbed to reduce deflections and stresses to a minimum. Exterior is neat appearing. Mounting bolts are large, so that stresses are never critical.

Note space in the single type casing. Generous housing size provides adequate oil reservoir and large radiating surface for thermal capacity.

2. Spiral-bevel gear is of ring design bolted to center spider. This permits use of ring forgings of light section and best materials for gear teeth. The center is made of high grade semi-steel. With this construction the slight distortions of the ring after carburizing and quenching are corrected by bolting down against the true surface of the center flange. A gear of solid construction would retain any heat-treatment distortions.

3. High speed pinion is made integral with shaft for high ratios. After carburizing and quenching, gear teeth are trued-up by means of "proof spots" and bearing seats and extensions are ground as final operation. This insures perfect concentricity. For lower ratios where large bore can be safely used in pinion, it is mounted separately and held in place with locknut. Shaft is then made of heat treated SAE-1040 steel.

4. Pinion thrust bearing is always located farthest from the pinion. This means that radial load is comparatively small, resulting in a better balance in size between thrust bearing and radial bearing. Bearing cartridge is designed to clamp the two angular contact bearings firmly together and also to permit axial adjustment of pinion to get proper tooth bearing. In smaller sizes, a double row integral type ball bearing is used.

5. Pinion radial bearing is located very close to the pinion, to reduce bearing reaction. There is no axial restriction. Bearing takes only pure radial loads. Note baffle used between pinion and bearing for small pinion diameters. This prevents "pumping" of oil directly from pinion into bearing. Generous span is used between radial and thrust bearings. This keeps bearing loads down to minimum, and provides rigid mounting for pinion and external overhung loads.

6. Tapered roller bearings are used on low speed shafts of single, double and triple reduction types. Gear load is shared by two bearings. Wide span keeps down bearing loads when overhung loads are applied to shaft extension.

7. Intermediate bearings of the double and triple reduction units carry very heavy loads. Thrust loads are balanced somewhat by selecting proper hand of cut in each set. Bearings on bevel gear shaft are arranged so that gear may be adjusted axially for proper tooth bearing.

8. Wherever splash lubrication is not effective to carry oil to all gears and bearings, a gear type oil pump is used. Pump is usually driven from bevel gear shaft, where speeds are most favorable.

9. For medium and high speeds flinger type labyrinth seal is used. Since there is no contact between stationary and rotating members, there is no wear, heating or power loss. For low speeds where flinger action would not be effective, ordinary packing type seal is used.

10. Adequate drainage is provided on all pinion shafts to prevent building up a level of oil at seal.

11. All vertical units are equipped with a "dry well." This keeps oil completely away from low speed shaft, thus making vertical units absolutely leak-proof. Lower bearing is grease lubricated. Gear is designed to act as an umbrella for top of dry well.

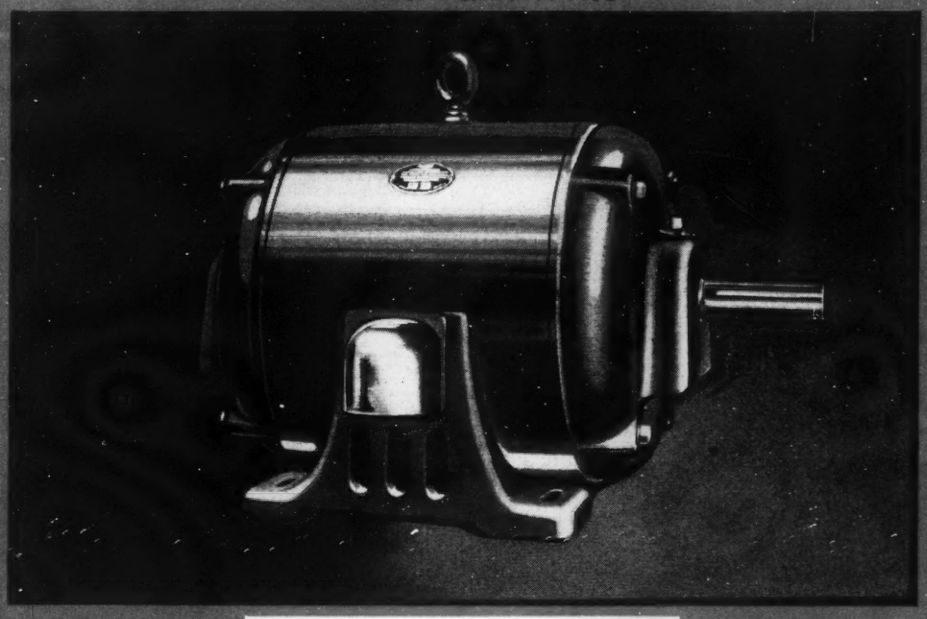
Send for the NEW 56 page Catalog No. 200

Philadelphia
GEAR WORKS INCORPORATED
ERIE AVE. AND G ST., PHILADELPHIA, 34, PA.
NEW YORK • PITTSBURGH • CHICAGO . . . IN CANADA: WILLIAM AND J. G. GREEY LIMITED, TORONTO

Industrial Gears and Speed Reducers
LimiTorque Valve Controls

B-LINE

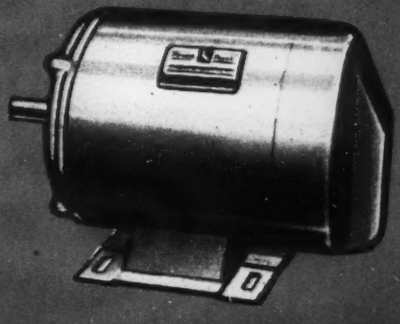
REG. U.S. PAT. OFFICE



B-LINE, 1/6 TO 30 HP.

Truly a Lifetime motor

POWER-POISE
1/6, 1/3, 1/2, 3/4 HP.



WRITE FOR
BULLETIN 5000 on MOTORS
BULLETIN 7000 on GRINDERS

PRODUCTS OF

DEPENDABILITY · LONG LIFE · ECONOMY
B LINE

POWER POISE

THE BROWN-BROCKMEYER CO

LEADING INDEPENDENT MOTOR MANUFACTURER

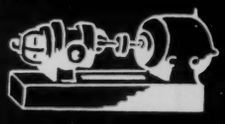
1030-1044 SMITHVILLE ROAD

DAYTON 1, OHIO

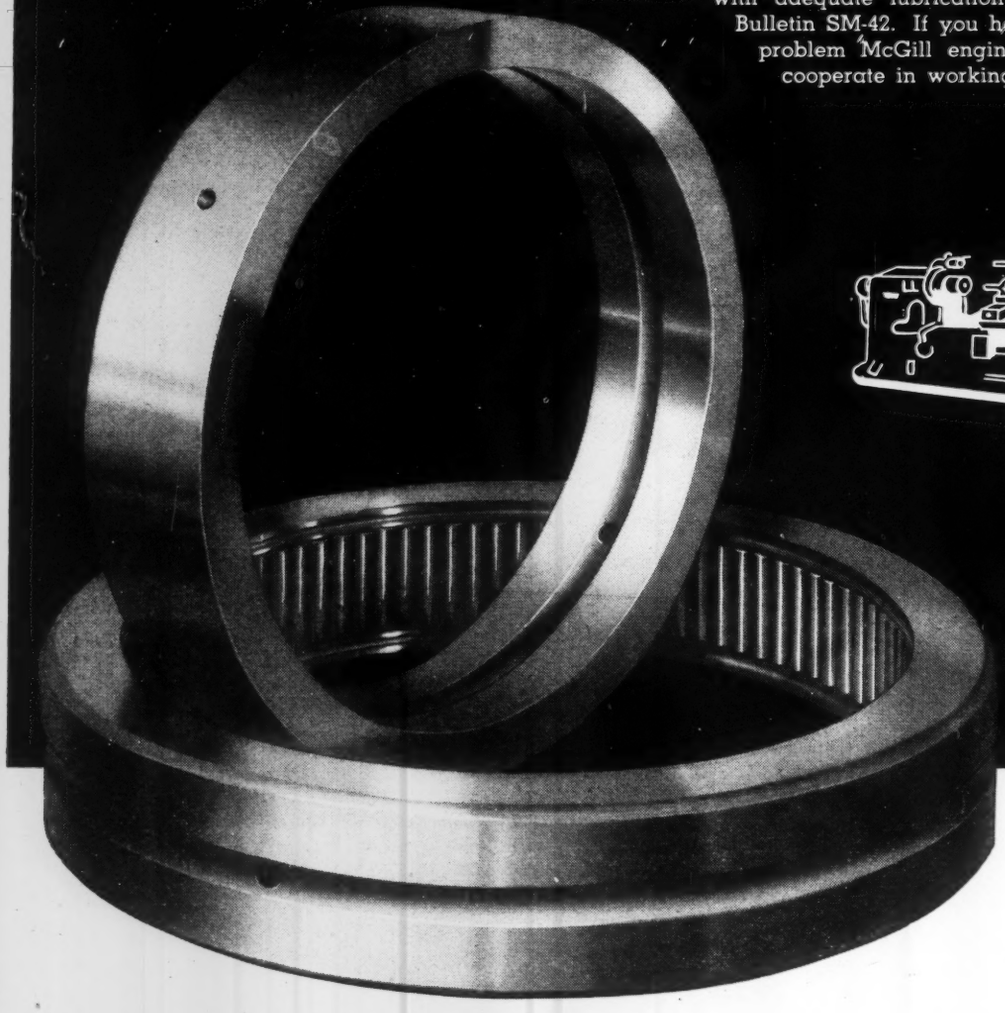
PLANTS AT DAYTON, WILMINGTON AND XENIA, OHIO—OFFICES IN PRINCIPAL CITIES

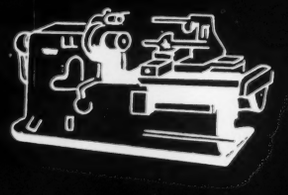
McGILL

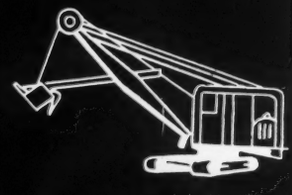
SOLIDEND MULTIROL *Bearings*



Designed as a self-contained unit, with races and rollers made from through-hardened high-carbon chrome steel, there are no loose parts to warp or break. The solidend shoulder construction and retaining lip, built integral with the outer race, hold the rollers, eliminating any possibility of the bearing coming apart during installation or operation. Rounded end, full length rollers give greater load carrying capacity, and close tolerance in construction, increases the overall efficiency. Where it is necessary to conserve radial space the bearing can be used without the inner race and the bearing mounted directly on the shaft. Provision for incidental thrust is provided along with adequate lubrication facilities. Write for Bulletin SM-42. If you have a special bearing problem McGill engineers will be glad to cooperate in working out a bearing to fit.







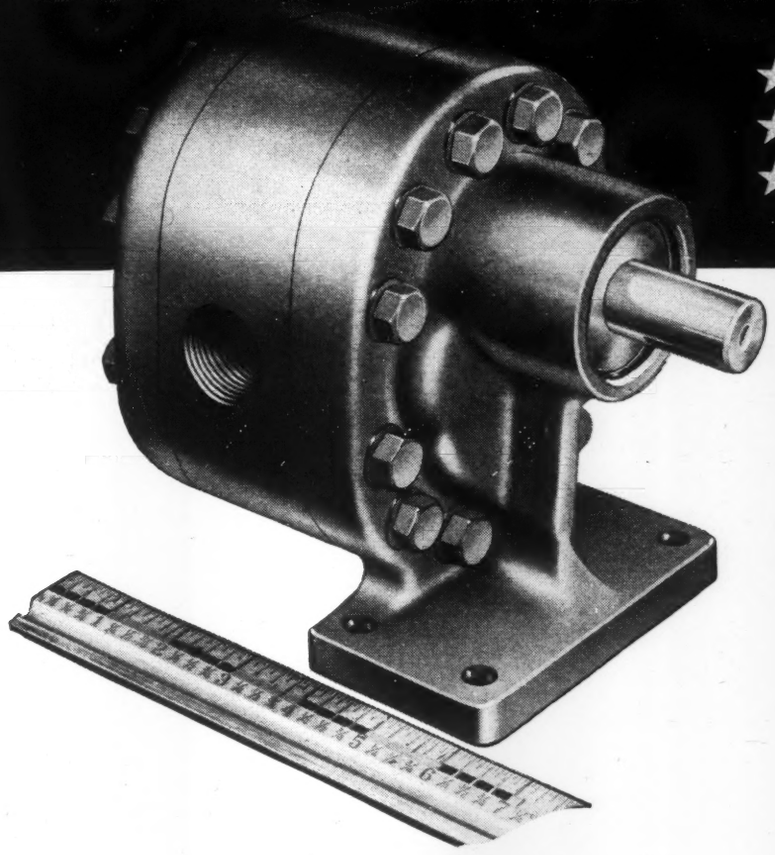
FOR ALL TYPES OF INDUSTRIAL EQUIPMENT

McGILL MANUFACTURING CO., INC.

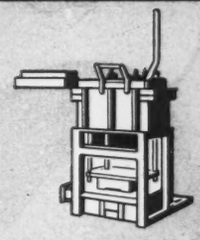
MANUFACTURERS OF BALL AND ROLLER BEARINGS — VALPARAISO, INDIANA

COMPACT · EFFICIENT · ADAPTABLE

THE NEW HYDRO-POWER *Cubline* HYDRAULIC OIL PUMP



- ★ 5" wide, 7" high, 7¼"—8¼" long*
- ★ Over-all efficiency—97%—1000 P. S. I.
- ★ Designed for these applications



Concrete Block-Making Machinery

Dump Trucks

Road Grading Machinery

Airplanes

Steel Mill Equipment

Bulldozers

A New Gear Pump To Fit YOUR Needs Built in Sizes of 10, 15, 20 Gallons Per Minute

Regardless of the type of applications for which you use oil hydraulic power—a "Cubline" pump can do your job—

Whether you're an individual or a manufacturer—it makes no difference. Whether a single dependable pump or ten thousand dependable pumps are your need—it makes no difference. Whether your use is for a pilot model experimental machine or for an expertly designed and engineered piece of equipment for resale—it makes no difference.

HYDRO-POWER, INC. can and will meet you on your own ground in offering . . . efficiency . . . compactness . . . adaptability to your use . . . and a price liberally adjusted to quantity orders.

In using the coupon below tell us your requirements and we'll tell you how we can meet them. Use it NOW!

AND . . .

- Tractor-Trailer Lifts
- Stone Pickers
- Snowplows
- Truck Elevators
- Scarifiers
- Ship Steering Gears
- Material Handling Equipment
- Extrusion Machinery
- Juicers
- Agricultural Machinery
- Balers
- Oil Extractors
- Molding & Die Casting Machines

HYDRO-POWER, INC.
Belmont and Sheridan Aves., Springfield, Ohio, U. S. A.

**Length: 10 GPM—7¼"; 15 GPM—7¾"; 20 GPM—8¼"*

hydro power

hydraulics

FOR DEPENDABLE PACKAGED POWER

Hydro-Power, Inc.
Belmont and Sheridan Aves.
Springfield, Ohio

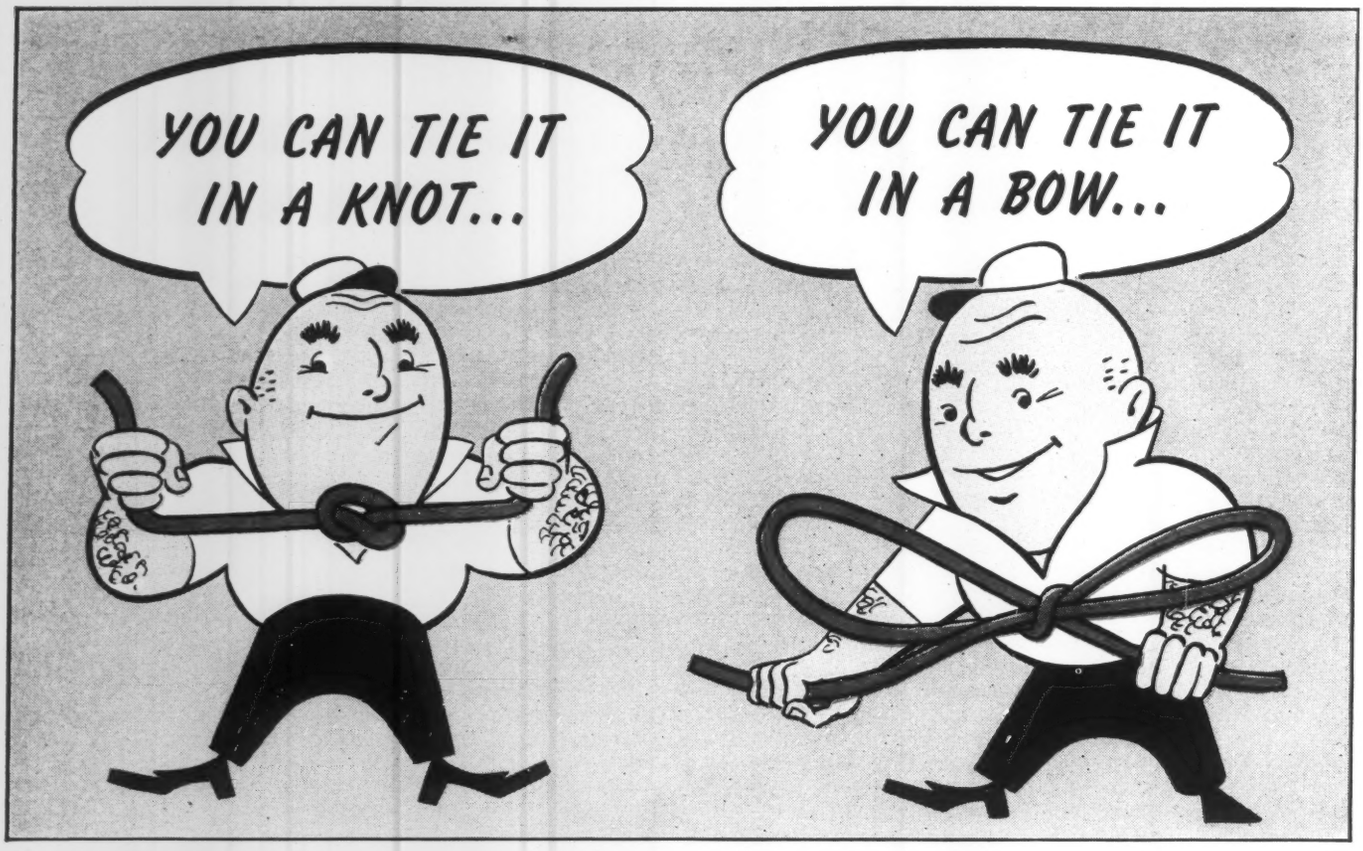
Yes! Send me literature on your new "Cubline" Pump.

Name_____ Title_____

Company_____

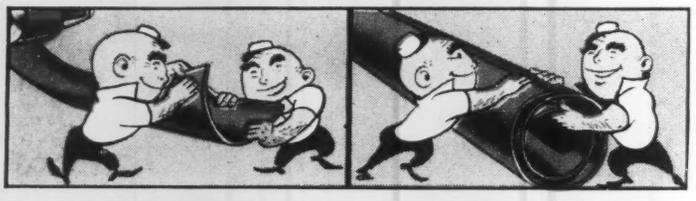
Street_____

City and Zone_____ State_____



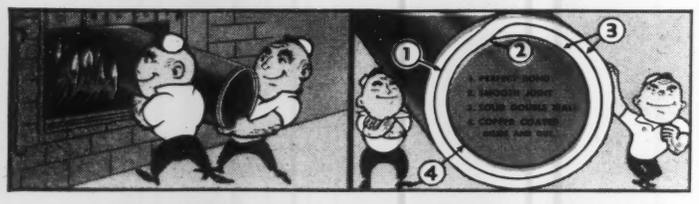
Bundyweld Steel Tubing Fabricates With Ease

WHY BUNDYWELD IS BETTER TUBING



1 Bundyweld Steel Tubing is made by a process entirely different from that used in making other tubing. A single strip of copper-coated S.A.E. 1010 steel is continuously rolled twice laterally . . .

2 . . . into tubular form. Walls of uniform thickness and concentricity are assured by the use of close tolerance cold rolled strip. This double rolled strip passes through a furnace where the . . .



3 . . . copper coating fuses and alloys with the double steel walls. After brazing and cooling, it becomes a solid double wall steel tube, copper brazed throughout 360° of wall contact . . .

4 . . . copper coated inside and out, free from scale, closely held to dimensions. Hard or annealed in standard sizes up to 5/8" O.D. Special sizes cold drawn. Also in Monel, nickel and nickel alloys.

When you rely on Bundyweld Steel Tubing, you realize extra economy.

You save precious time in production, because this modern tubing fabricates with ease. And you gain in dependability, because of the strength imparted by Bundyweld's unique solid, double-wall construction. Bundyweld meets three vital tubing needs:

- **Great Resistance to Vibration Fatigue**
- **High Bursting Point in Pressure Applications**
- **Low Cost**

Every working day, nearly two million feet of Bundyweld Steel Tubing roll out of our plant to become vital parts in motor vehicles, cooling equipment, gas ranges and other items of modern industry.

The chances are good that Bundyweld can help your products, too. Write today. *Bundy Tubing Company, Detroit 14, Michigan.*

BUNDY TUBING

ENGINEERED TO YOUR EXPECTATIONS

BUNDY TUBING DISTRIBUTORS AND REPRESENTATIVES

Pacific Metals Co., Ltd.
3100 19th St.
San Francisco 10, Calif.

Standard Tube Sales Corp.
1 Admiral Ave.
Maspeth, N.Y.C., N.Y.

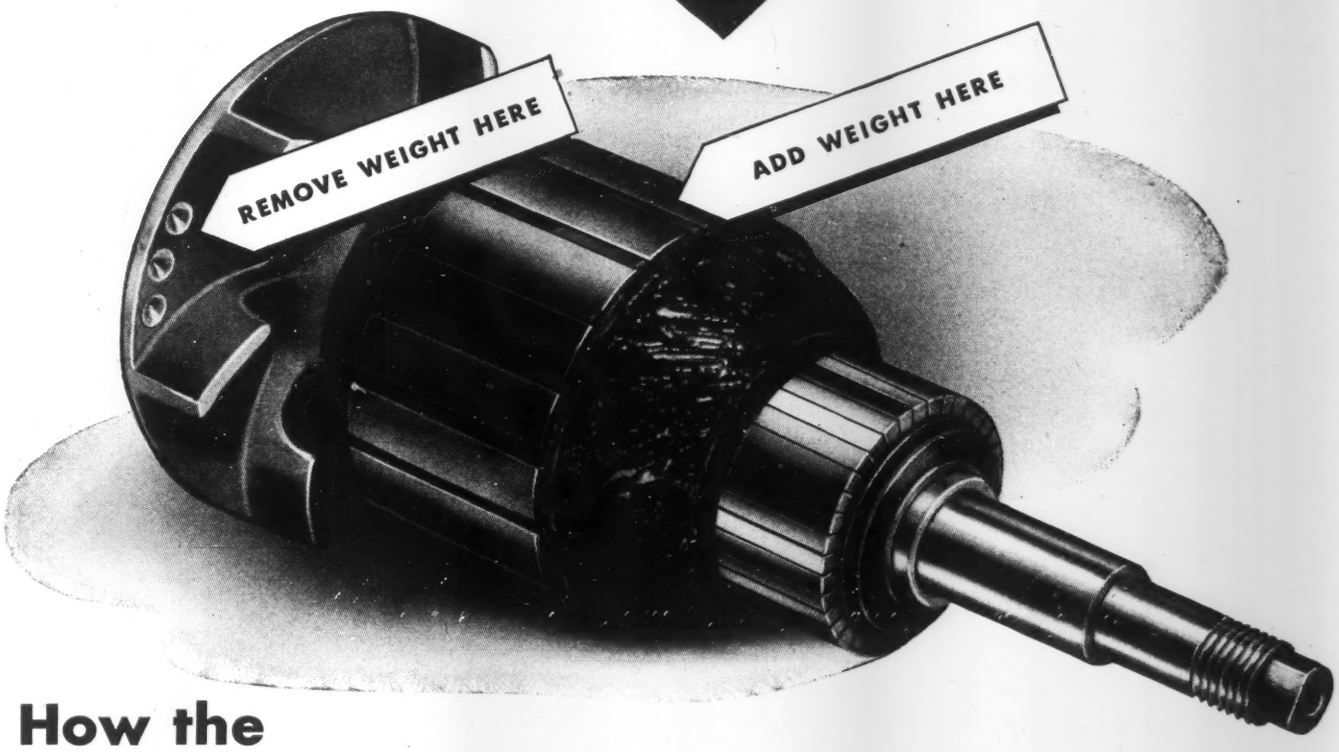
Lapham-Hickey Co.
3333 W. 47th Place
Chicago 32, Illinois

Rutan & Co.
404 Architects Bldg.
Phila. 3, Pa.

Eagle Metals Co.
3628 E. Marginal Way
Seattle 4, Wash.

Alloy Metal Sales Ltd.
861 Bay St.
Toronto 5, Canada

FOR PERFECT BALANCE



How the
GISHOLT DYNETRICS*
make it quick and easy

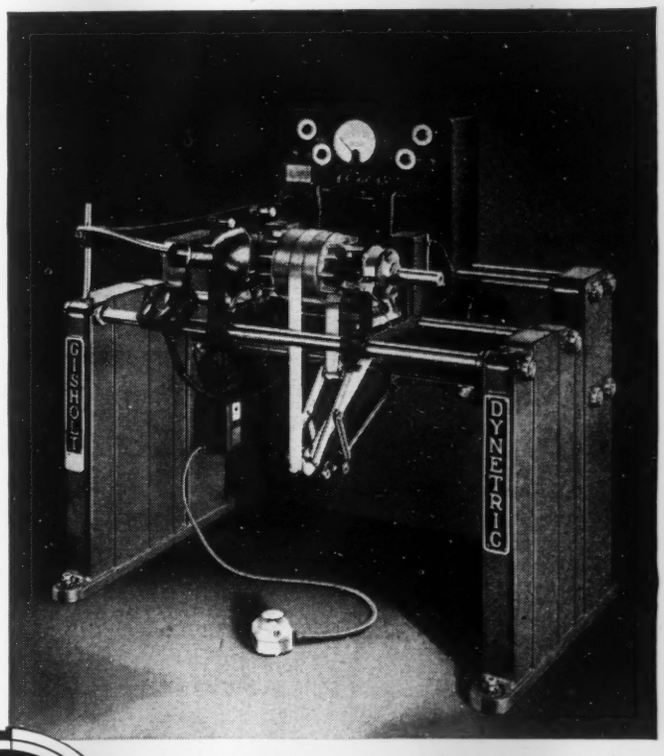
Here's a small universal armature with ventilating fan. Obtaining dynamic balance in the part requires that correction be made in each end—(1) the *fan end* by drilling to remove weight, and (2) the *commutator end* by adding weight, in the form of slugs, in core slots.

To determine the amount of correction to apply on each end of the part, the Dynetric can be calibrated to indicate the number of holes to be drilled in the aluminum fan and, by simply throwing a switch, the number of 1/64" units of slug length to insert in slots in the armature.

Although correction units are different on each end of the rotor, and although one indication is for *removal* while the other is for *addition* of weight, the Dynetric can do it easily and quickly, saving time and money on every piece.

This is another example of the Dynetric's ability to answer a great variety of balancing problems. Ask for complete information.

**Developed jointly with Westinghouse Electric Corporation*

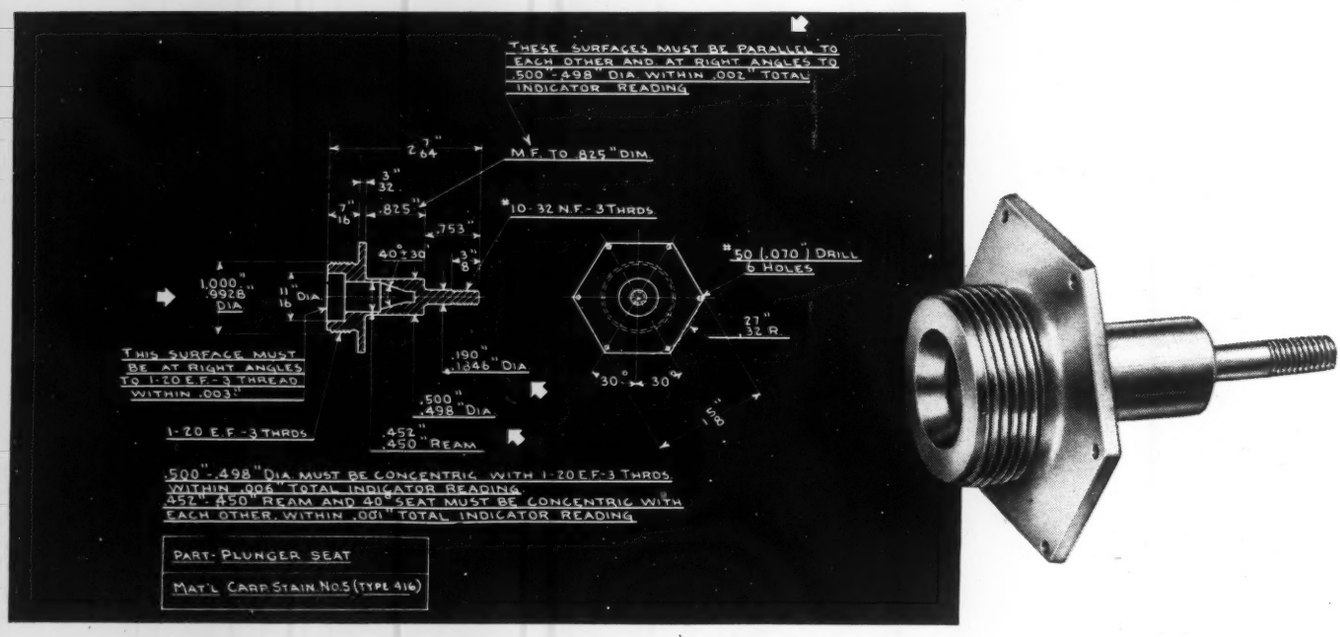


A GISHOLT TYPE S DYNETRIC BALANCING MACHINE shown balancing an induction motor armature which is supported on its own ball bearing housing. This is just another of the variety of parts ranging from a fraction of an ounce to many tons which can be Dynetrically balanced.

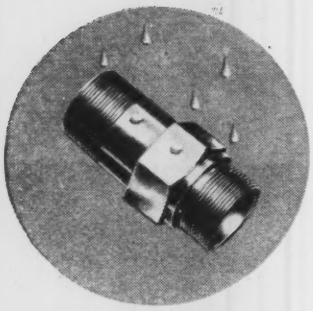
GISHOLT MACHINE COMPANY
1245 E. Washington Ave. • Madison 3, Wisconsin

Look Ahead...Keep Ahead...With Gisholt

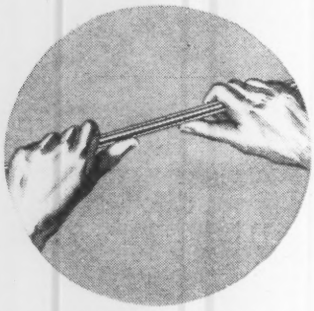
TURRET LATHES • AUTOMATIC LATHES • SUPERFINISHERS • BALANCERS • SPECIAL MACHINES



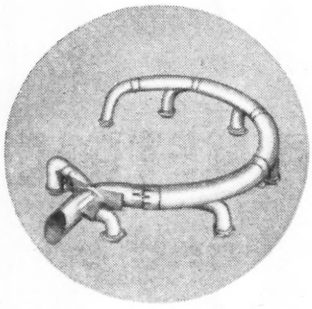
Look at the Advantages you get with *Carpenter* Stainless



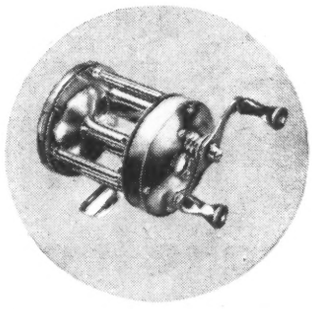
Corrosion Resistance that gives your products more durability, greater dependability, is one of the things you get with Carpenter Stainless.



Strength and Rigidity is an important design consideration in hundreds of light weight products made from Carpenter Stainless.



Heat Resistance for continuous or intermittent service is another advantage that Carpenter Stainless gives you.



Gleaming Sales Appeal is "automatically" a part of your products when they are made from Carpenter Stainless

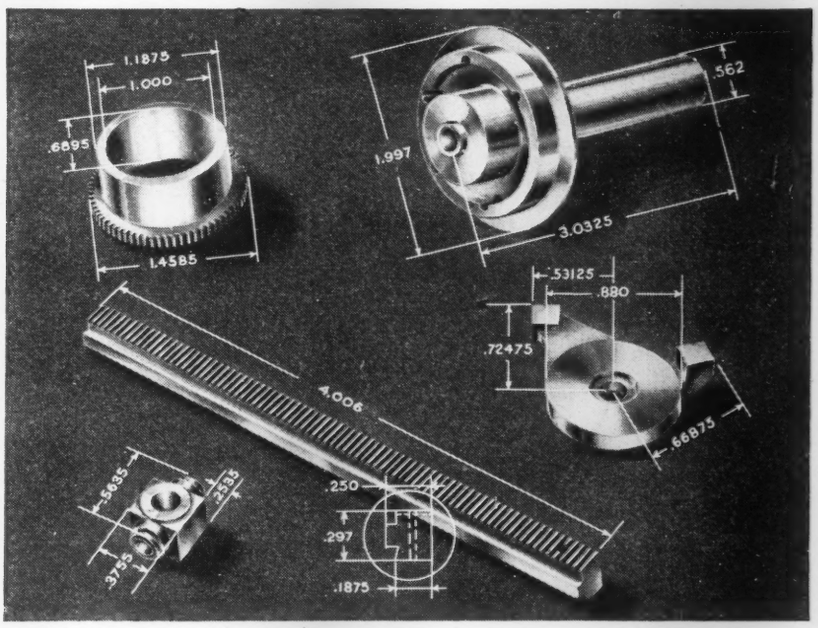
On jobs where Stainless is used to improve product performance or to give you new sales features, there are good reasons why your first choice should be Carpenter Stainless. You can count on the fact that each lot will behave perfectly in your machines, help you cut production costs and eliminate rejects.

And just as important, you can get this Stainless right out of your nearby Carpenter warehouse stocks. If you are not already one of the many who are saving dollars by using Carpenter Free-Machining Stainless . . . send in your order today. Just call your nearest Carpenter warehouse.

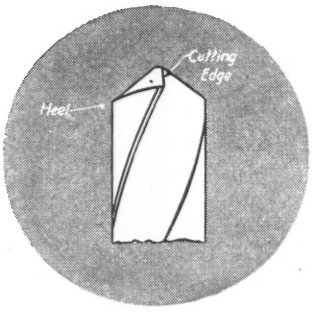
Carpenter **STAINLESS STEELS for**

Strength
Rigidity
Heat Resistance
Corrosion Resistance
Longer Product Life
Sales Appeal

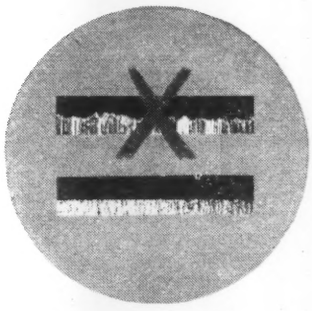
It's really no trick at all to turn out close tolerance Stainless jobs at a profit when your orders specify *Carpenter* Free-Machining Stainless bar stock.



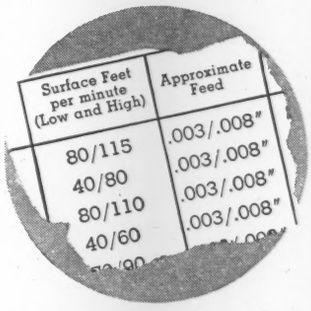
...Here is the Know-How of Fabricating Stainless



How to double-check your tool grinding on each job.

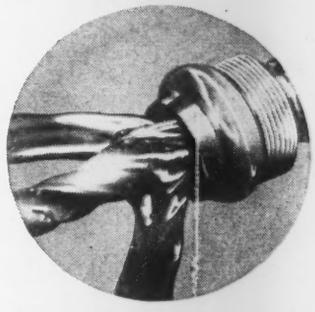


Why stoned edges produce better finishes and last longer.



Surface Feet per minute (Low and High)	Approximate Feed
80/115	.003/.008"
40/80	.003/.008"
80/110	.003/.008"
40/60	.003/.008"

How correct speeds and feeds save time and money on every job.



How proper lubrication cuts machining costs.

Start today to put Carpenter's diversified Stainless experience to work on each and every job. You can do it by calling in your nearby Carpenter representative. Ask him for the new Carpenter "Notebook on Machining Stainless Steels." He will be glad to give personal copies of the NOTEBOOK to Production and Management Executives. And after you have it, if you want additional copies for the men in your plant, they are available at 50c apiece. Drop us a line today.

THE CARPENTER STEEL COMPANY, 120 W. BERN ST., READING, PA.

Carpenter

FREE-MACHINING

STAINLESS STEELS

more than corrosion resistance

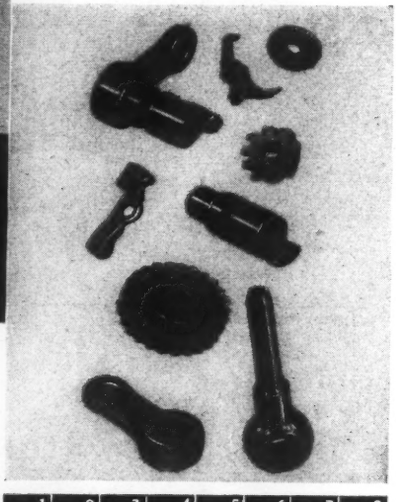
PROMPT SHIPMENT FROM CONVENIENTLY LOCATED STOCKS

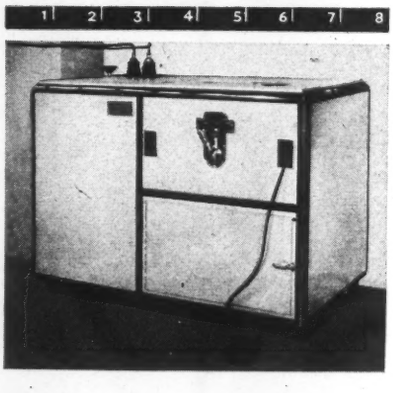
Buffalo	Cleveland	Hartford	Philadelphia
Chicago	Dayton	Indianapolis	Providence
Cincinnati	Detroit	New York	St. Louis

SEE THE CLASSIFIED SECTION OF YOUR TELEPHONE DIRECTORY

KERR *Engineered* INDUSTRIAL PRECISION CASTING EQUIPMENT

Pioneering in a Great New Industry





4 Outstanding Features of Kerr Centrifugal Casting Machine

1. **Developed under actual operating conditions by Kerr engineers.**
2. **Produces intricate industrial precision castings to close tolerances with minimum machining.**
3. **Produces uniformly sound castings in quantity.**
4. **Casts up to weights of 2 lbs., net, and widths to 4 inches, lengths to 5 inches.**

OTHER KERR PRODUCTS

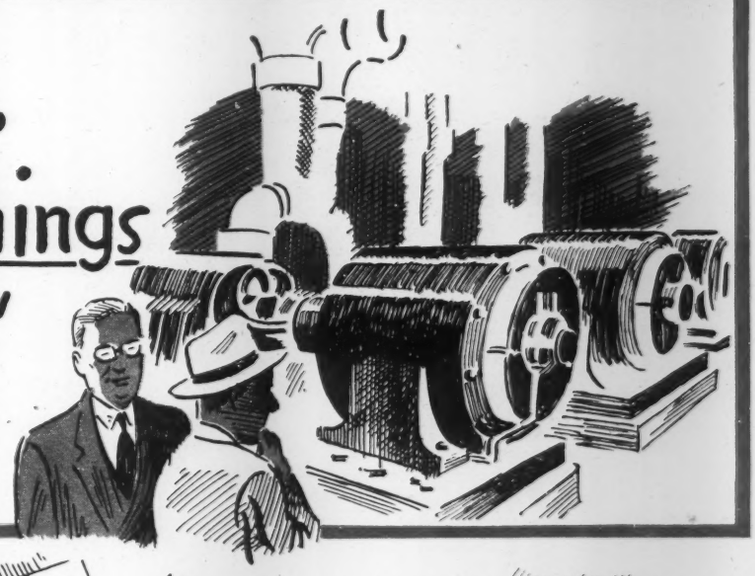
Kerr High Frequency Melting Tables (Up to 4 lbs. of steel per melt)
Kerr Vacuum Pumps (29.6 inches of vacuum – 12.5 C.F.M.)
Kerr Cristobalite Investment for Non Ferrous Metals
Kerr Ferrolite Investment for Ferrous Metals
Kerr Industrial Precision Pattern Waxes

KERR MANUFACTURING COMPANY

6081 TWELFTH STREET • DETROIT 8, MICHIGAN

"For This Job, Give Me Two Things in a Motor"

. . . said the Power Plant Engineer



"To Drive Boiler Feed Pumps, motors must first be *simple*. For example, take these three Allis-Chalmers 800 hp, 3600 rpm motors. They're 2-pole, squirrel-cage, single winding machines . . . with practically fool-proof rotors and sleeve bearings. But second, and even *more* important . . .

They've Got to be Dependable! Here's what I mean. These same motors have given us 17 years of uninterrupted service. We've had to order replacement parts for them only twice . . . at a total cost of less than $12 a year. We call that *good performance* . . . the kind we've come to expect of *all* your motors!"

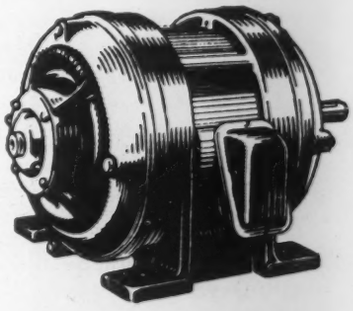
Frankly, Mr. Reader, we *are* mighty proud of our 2-pole motors. We've been developing them for high-speed requirements like this from the very earliest. Licked a lot of problems too. Like cutting down noise through better design . . . reducing windage noise with proper baffling, and curbing magnetic noise. . .

We're Getting Better Efficiencies and power factor . . . and lower starting kva, through improved squirrel-cage design. We've designed bearing brackets generously for greater structural rigidity. In fact, all the way around you can expect to find long life and low maintenance built-into our motors!

Yes, "A-C" Means Long Life in Motors!

REGARDLESS of size or type you'll be money ahead with Allis-Chalmers motors. For at A-C you can expect and *get* the same careful engineering, generous design and long-life operation that thousands of motor buyers have come to rely upon through the years.

And remember . . . while many jobs call for special or modified motors, there are *many more* that can be solved with *standard* motors . . . at less cost . . . and often with saving in time! ALLIS-CHALMERS, MILWAUKEE. A 2082



ALLIS CHALMERS

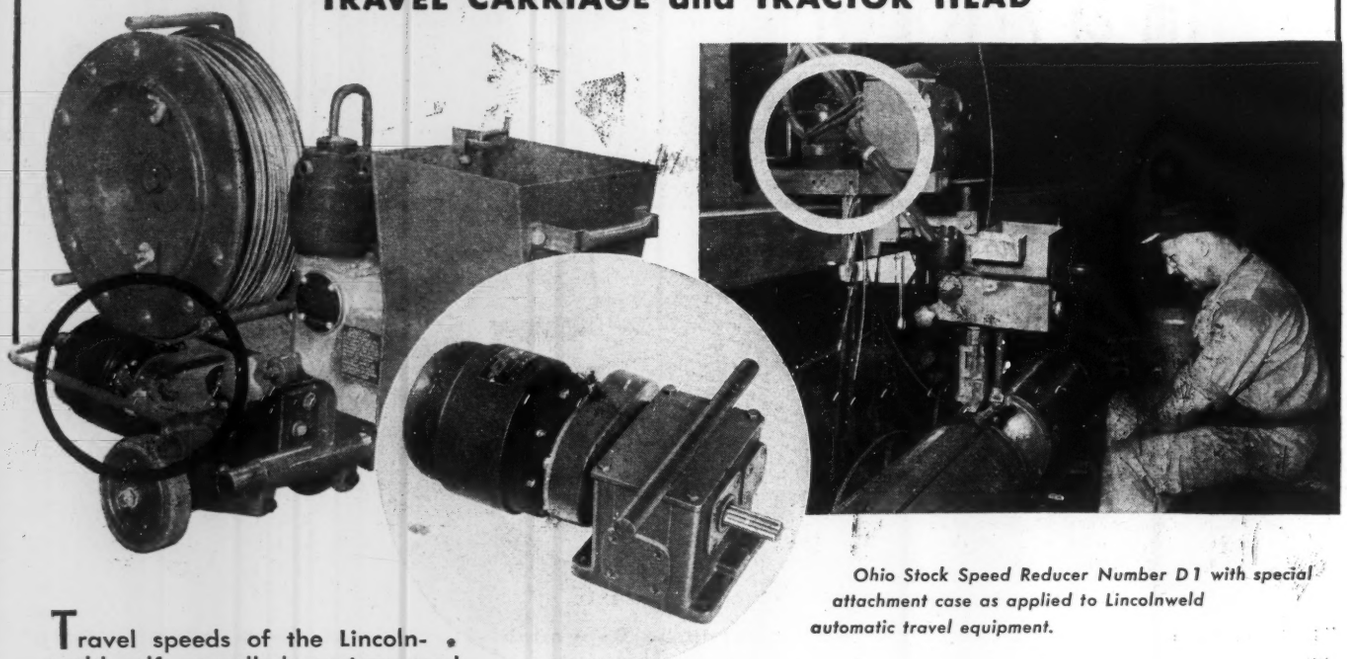
One of the Big 3 in Electric Power Equipment — Biggest of All in Range of Industrial Products

OHIO STOCK SPEED REDUCER

TRANSMITS TRAVEL POWER for

"Lincolnweld"

TRAVEL CARRIAGE and TRACTOR HEAD



Ohio Stock Speed Reducer Number D1 with special attachment case as applied to Lincolnweld automatic travel equipment.

Travel speeds of the Lincolnweld self propelled carriage and tractor heads for automatic welding are dictated by the welding job in hand. Movement must be smooth. Speed must be precision controlled. The entire propulsion unit consists of an electric motor, an attachment case and an Ohio Stock Speed Reducer.

Lincoln Electric Company engineers early recognized the savings possible if a stock reducer could be used in this application. After experimentation the engineers selected an Ohio Stock Gear Reducer.

They found these savings:

1. Heavy tooling expense is avoided.
2. Parts inventory investment is unnecessary.
3. Because it is a stock reducer, cost is lower.
4. Customers are insured quicker replacement, less costly downtime.

. . . and for more than a decade, Lincoln users have continued to profit by these savings which Lincoln has passed on to them.

Ohio Stock Speed Reducers and Gears may offer definite advantages for your product. Check with our engineers today.

THE OHIO GEAR COMPANY
1338 EAST 179th STREET • CLEVELAND 10, OHIO

REPRESENTATIVES

BUFFALO, 16, N. Y.
F. E. Allen
1315½ Hertel Ave., Room 9

DETROIT 26, MICH.
George P. Coulter
4 W. Larned St.

GRAND RAPIDS 8, MICH.
Slaughter Manufacturing Co.
3753 Division Ave., S.

INDIANAPOLIS 4, IND.
A. R. Young
635 N. Pennsylvania St.

*KANSAS CITY, MO.
Kansas City Rubber & Belting Co.
712 Delaware Street

*LOS ANGELES 21, CALIF.
J. W. Minder Chain & Gear Co.
927 Santa Fe Avenue

LOUISVILLE, KY.
Alfred Halliday, 330 Starks Bldg.

*MINNEAPOLIS 4, MINN.
Industrial Supply Co.
1100 Third Ave., South

NEW ENGLAND
George G. Pragst
P. O. Box 995, Pawtucket, R. I.

*NEW YORK 13, N. Y.
Patron Transmission Co.
129 Grand St.

N. KANSAS CITY 16, MO.
Sesco Engineering & Supply Corp.
15th Ave. & Clay St.

*PITTSBURGH 30, PA.
Standard Machinists Supply Co.
South 2nd and McKean Street

*PORTLAND 4, ORE.
J. W. Minder Chain & Gear Co.
411 So. West First St.

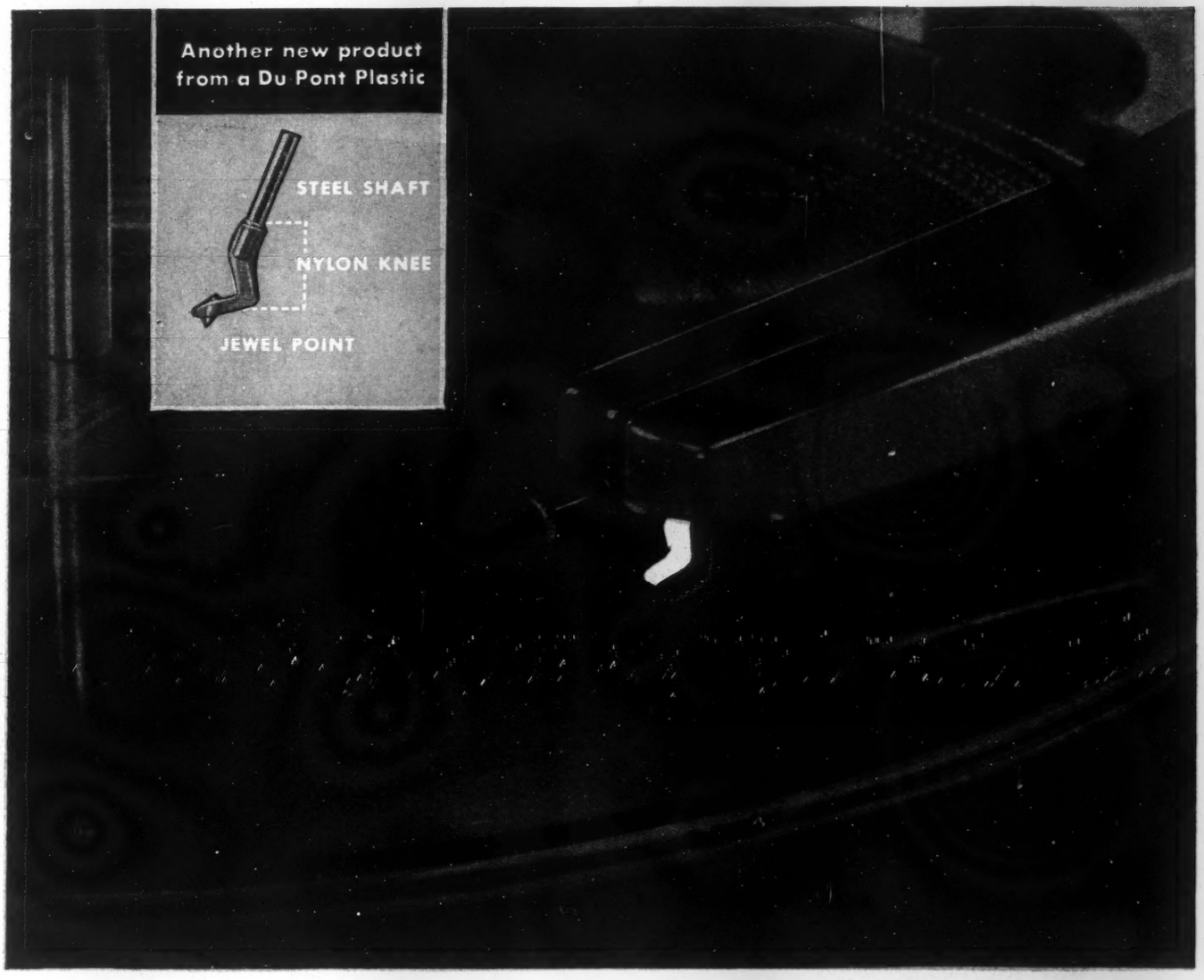
*SAN FRANCISCO 3, CALIF.
Adam-Hill Co.
244-246 Ninth St.

IN CANADA

*MONTREAL, CANADA
John Braidwood & Sons, Ltd.
66 Nazareth Street

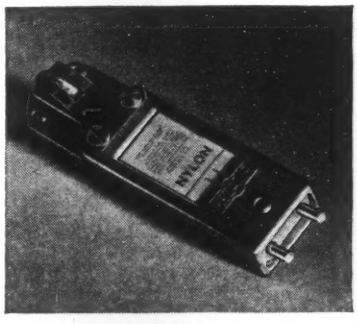
**Stocks carried.*

OHIO GEARS



NEEDLE WITH A NYLON KNEE

Better tone . . . new profits . . . based on Du Pont NYLON



New cartridge pickup has Du Pont nylon chuck

Made to improve reproduction, needle life and record life, this new pickup cartridge for phonograph arms contains a tapered nylon chuck to grip nylon needles. Made by the Astatic Corporation. Molded nylon parts supplied by Nosco Plastics.

"A real achievement," said a leading manufacturer of fine phonographs about the tone pickup of this sales-stirring new nylon needle.

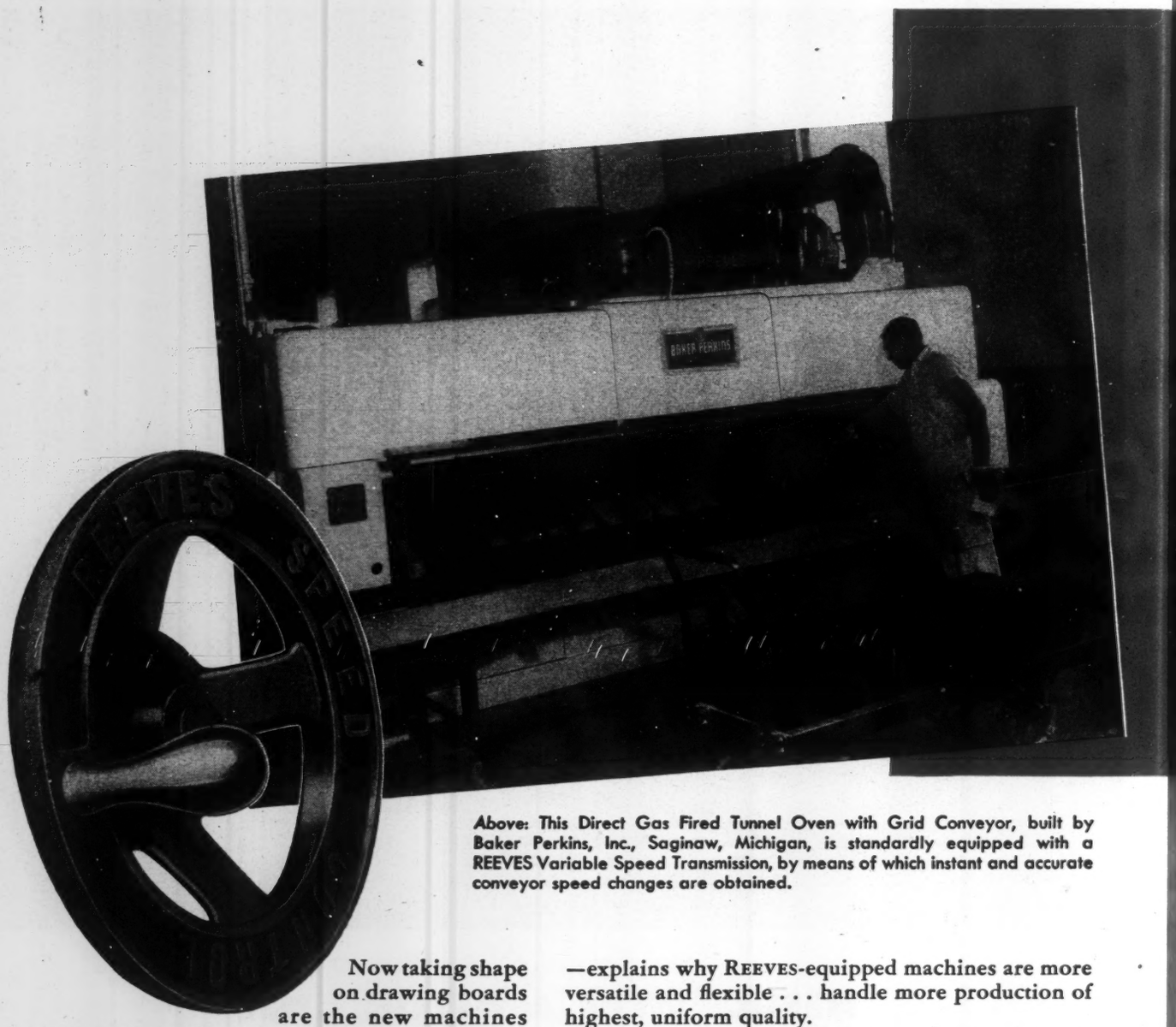
Because of its flexible knee-like bend, this needle minimizes record wear and needle scratch too. It shock-absorbs unwanted record vibrations, and it's so tough it's almost break-proof in ordinary use. It grasps the jewel tip in a vise-like grip . . . obviates the need for rigid mountings. Production-wise, nylon molds uniformly . . . keeps output up and costs down. All told, it provides a new slant on an old product to help keep sales on the up-curve.

Look to nylon . . . and other Du Pont plastics . . . for new-product possibilities and for adding sales appeal to the old.

Write now for literature. It will pay you to have it in your files. E. I. du Pont de Nemours & Co. (Inc.), Plastics Department, Room 392, Arlington, N. J.

Nylon needle designed and manufactured by Hutter Development Co. Distributed by Decca Records, Inc., and Chicago Webster Corp.

DU PONT
REG. U. S. PAT. OFF.
Plastics
BETTER THINGS FOR BETTER LIVING
. . . THROUGH CHEMISTRY



Above: This Direct Gas Fired Tunnel Oven with Grid Conveyor, built by Baker Perkins, Inc., Saginaw, Michigan, is standardly equipped with a REEVES Variable Speed Transmission, by means of which instant and accurate conveyor speed changes are obtained.

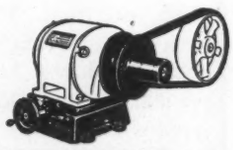
Now taking shape on drawing boards are the new machines you'll place in production a year or two from now. To make sure that these machines fulfill the promise of *better things to come* through the performance of more jobs, more efficiently . . . make sure that your blueprints incorporate REEVES Speed Control.

As proved in standard equipment applications on more than 2,100 different makes of machines, REEVES drives and controls provide the right speed for every operation and every operator under every changing condition. This infinite, stepless *speed adjustability*—obtained accurately and instantly without shut-downs—explains why REEVES-equipped machines are more versatile and flexible . . . handle more production of highest, uniform quality.

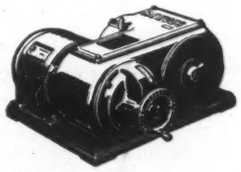
At present, deliveries can't keep up with demand, but there'll be more REEVES units by the time your new models are ready to roll. So we suggest that you call in a REEVES field engineer now to discuss the application of REEVES Speed Control to your machines. There's a wide selection of designs, sizes, speed ratios and controls to choose from—also "internal operating parts only" for incorporation within the framework of the machine. The entire line is fully covered in a comprehensive, 96-page catalog—write for it, asking for No. H-450.

THE THREE BASIC REEVES SPEED CONTROL UNITS

VARIABLE SPEED TRANSMISSION for providing infinite, accurate speed flexibility over a wide range—2:1 to 16:1. Sizes—fractional to 87 hp.



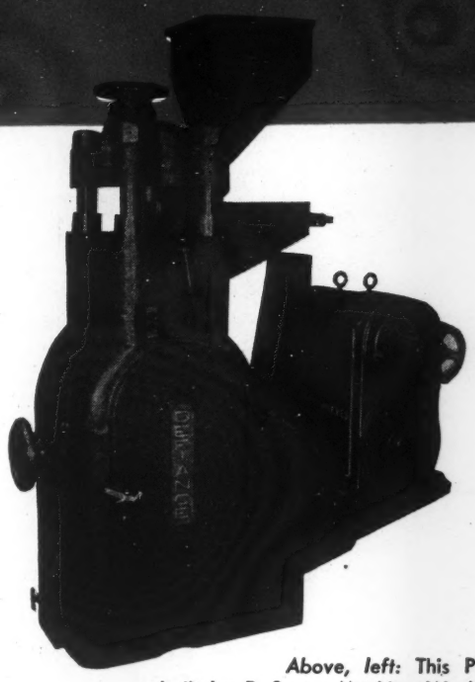
VARI-SPEED MOTOR PULLEY converts any standard constant speed motor to a variable speed drive within 4:1 ratio. Sizes to 15 hp.

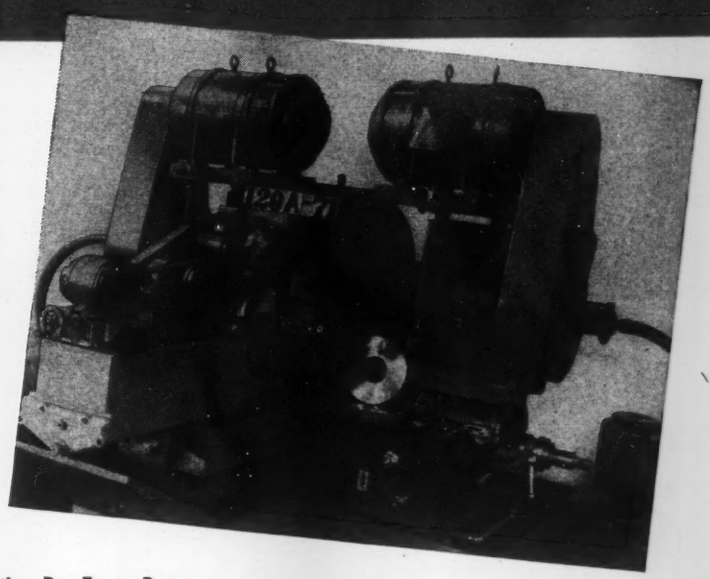


MOTODRIVE combines motor, speed varying mechanism and reduction gears in single compact unit. Speed variations 2:1 to 6:1 inclusive. Sizes to 15 hp.

In Your Blueprints of Better Things to Come— Provide for Reeves Speed Control

Below: In grinding spring-steel automobile seat plates to .055" thickness, accurate variable speed control is essential. That's why a REEVES Vari-Speed Motor Pulley is standard equipment on this Double Grinder, built by Gardner Machine Company, Beloit, Wisconsin.





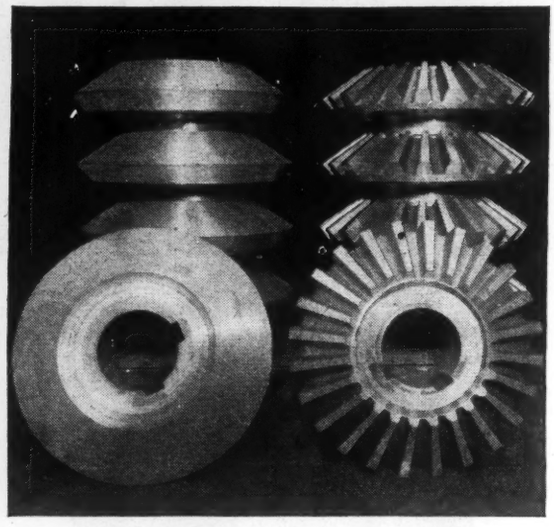
Above, left: This Plastics Pre-Form Press, built by Defiance Machine Works, Inc., Defiance, Ohio, can produce a million 7/16" diameter tablets a day on a 13-cavity die. Accurate variable speed control, provided by a REEVES Motodrive, is standard equipment.

REEVES PULLEY COMPANY • COLUMBUS, INDIANA

Accurate Variable
REEVES Speed Control
Gives the Right Speed for Every Job!

Recognized Leader in the Specialized Field of Speed Control Engineering

STRENGTH HIGH... WEIGHT LOW



Would you welcome an idea that would save weight and still meet all requirements for strength?

Consider the solid advantages of Bethlehem's circular steel forgings. Topping the list is the high strength created by our unique rolling-and-forging process. Because of this extra strength, thinner sections are often made possible . . . hence savings in weight.

But that's not the only advantage. There are others . . . uniform metal density, homogeneity, fine surface qualities. And we ship these forgings rough-machined, thereby reducing operations for the customer.

Specify Bethlehem rolled-and-forged circular products for gear blanks, crane wheels, sheave wheels, tire molds, turbine rotors, and similar applications. These products can be furnished in carbon or alloy steel, heat-treated or untreated, and in sizes from approximately 10 in. to 44 in. OD.

BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation

★ BETHLEHEM STEEL ★

BETHLEHEM ROLLED-and-FORGED CIRCULAR PRODUCTS

Wichita City Library

Whatever combination of conditions your springs must fight...

CORROSION • RUST • HEAT • COLD • HIGH STRESS • FATIGUE

Whatever type of spring you need...

COMPRESSION • EXTENSION • TORSION • SPIRAL • FLAT • CLIP • RETAINER • GARTER • BANANA

Consider these alloys first...

MONEL* • "K" MONEL* • INCONEL* • "Z" NICKEL* • NICKEL

There is no need to put up any longer with repeated troubles that can be avoided by using INCO Nickel Alloy springs for corrosive conditions and elevated or sub-zero temperatures.

Now, rustless, high-strength springs can be made of five different INCO Nickel Alloys to withstand corrosive attack and temperatures up to 750°F. or even higher.

And they cost so much less than special alloy springs that it is practical to use them for any application where heat, corrosion or fatigue are causing you trouble with ordinary spring parts.

NICKEL (INCO TRADE MARK) ALLOYS

HERE'S A CHANCE TO GET RID OF THE SPRING PROBLEM THAT HAS BEEN BOTHERING YOU

Send for "ANALYZING THE SPRING PROBLEM." When you get this simplified worksheet, jot down the data about your spring problem and what you want in a spring. The information you supply, plus our service records and test data, will enable us to judge which material can be recommended for your particular service. Then, we will cooperate with your spring manufacturer to work out the answer to your problem. That is all you need to do. Write today for "ANALYZING THE SPRING PROBLEM."

THE INTERNATIONAL NICKEL COMPANY INC., 67 WALL STREET, NEW YORK 5, N. Y.

Our specialty is

high-pressure pumps

not

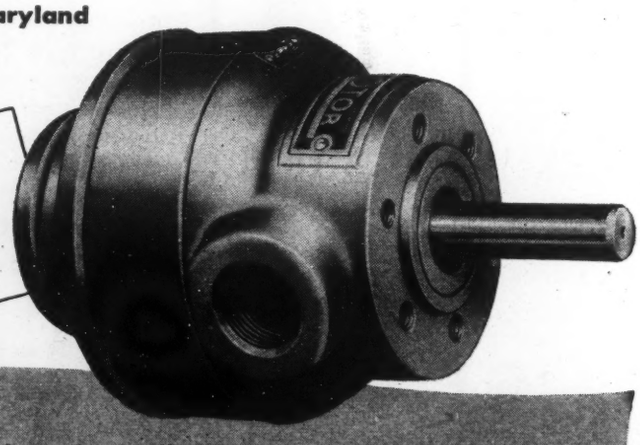
high-pressure selling

Gerotor hydraulic pumps are specified because they deliver sure-fire performance . . . not because we deliver a rapid-fire sales talk.

For example, if your products require hydraulic pumps with operating pressures up to **1500** p.s.i. intermittent, **1200** p.s.i. continuous . . . with a capacity of 3, 5, 8 or 12 g.p.m. . . . the new Gerotor type **QH** is "made to order" for you. Write for folder in which the facts speak for themselves.

You can expect efficient, dependable pumps . . . prompt delivery . . . **and** friendly, helpful service . . . whenever you deal with Gerotor.

GEROTOR MAY CORPORATION **Baltimore 3, Maryland**



GEROTOR

hydraulic pumps, valves, cylinders

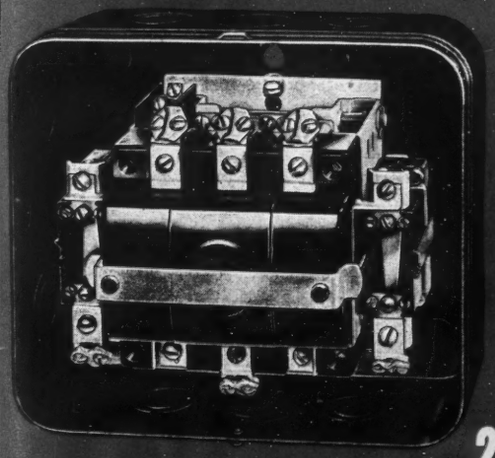
RIGHT ANGLE TYPE "RA" MAGNETIC STARTER

ARROW AH HART

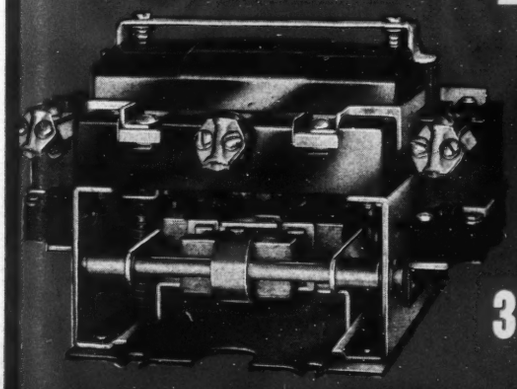
NEW No.2

NEW PRINCIPLE • BALANCED MECHANISM

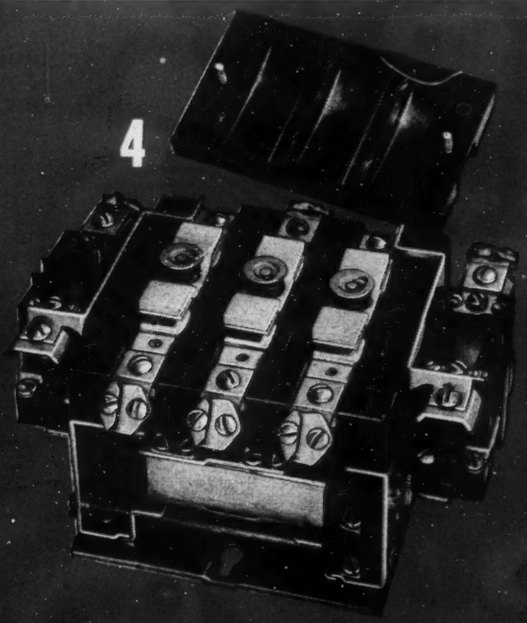
1



2



3



4

(1) *Small, compact* Here's the smallest Size 2 Starter ever developed — and having the biggest contacts. Dimensions with Enclosure: 9⅛" width; 8⅛" height; 5" depth.

(2) *Easy-to-wire* Designed for straight-through wiring. Line wires connected at one end and load wires at opposite end. Compact mechanism leaves more wiring room in box.

(3) *Fast hook-ups* Terminals front-wired; easy to get at. Connecting wires can be cut even. Straight-through wiring eliminates bending or forming heavy lines.

(4) *Arc control* Shape of contacts, and broad line of contacting area cuts the arcing to a new minimum. An individual arc chamber completely encloses each contact.

This switch makes use of a new, *original* development in solenoid starter mechanism, — not merely an improvement but a basic new operating *principle.* The Right-Angle BALANCED mechanism multiplies the 15-pound magnet pull to 25 pounds at the contacts, requiring but 8.5 Watts closed and 75 Watts inrush. Only the magnet plunger of 7 ozs. weight, works against gravity when the magnet is closing. The Right-Angle moving mechanism is *balanced* to provide full use of magnet power without lifting extra weight. Contact carrier is guided in perfect alignment in straight-line horizontal action, bringing equal contact pressure to each pole. This new-type action is engineered to produce a switch about *half the size* of the conventional motor starter... Write for illustrated 4-page folder giving out the full particulars of the features you'll want in your Starters from now on!

INDUSTRIAL CONTROL DIVISION

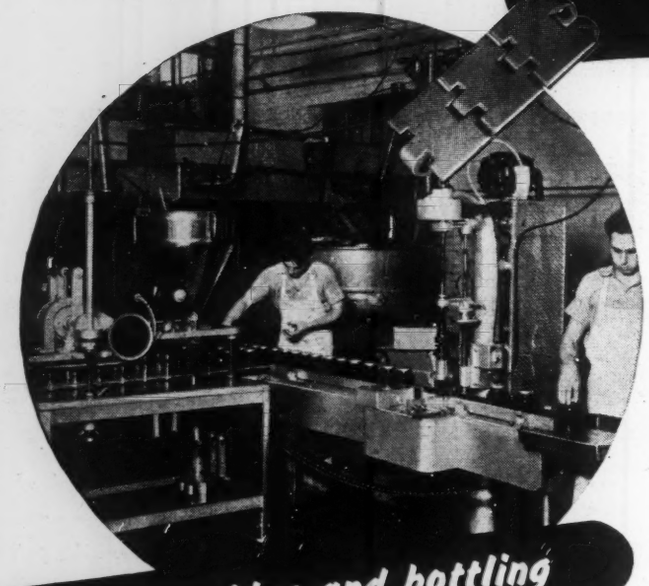
ARROW-HART & HEGEMAN ELECTRIC CO., HARTFORD 6, CONN.

Contacts

Illustration below shows design of long-life contacts. Curved movable tips against flat stationary tips give a broad line-of-contact surface which improves with use.

TYPE "RA"

What's the ask the Rex man!



for packing and bottling

for farm implements

No matter what type of machine you design . . . construction machinery, farm implements, packaging and bottling machines, ovens, etc. . . . you can simplify your chain selection problems by consulting the Rex Man.

You'll find him an expert in power transmission and conveying . . . ready, willing and able to assist you to specify the chain that will be right for the job . . . that will assure the best in efficient, economical service.

The Rex Man is an experienced chain application engineer and he's backed by a complete line of chain belts, manufactured in every avail-

REX CHAIN BELTS

right chain?

for construction machinery

able size and type. With his assistance, you will avoid high cost due to overchaining and excessive wear and breakage caused by underchaining. He will demonstrate how a properly engineered chain drive can save space, help simplify design, and add to product salability by reducing maintenance costs and prolonging service life.

There is a standard Rex chain belt that exactly fits your design requirements and the Rex Man can help you select that *right* chain for your every need! Call him or write direct to Chain Belt Company, 1643 West Bruce Street, Milwaukee 4, Wisconsin.

for ovens

CHAIN BELT COMPANY
of Milwaukee . . . . . .

IN your continuing effort to improve operating performance, you'll want to keep in mind the inherent advantages that Trentweld tubing offers in making machines better—more lasting—and more useful.

For example, this thin-walled or thick-walled tubing is specifically engineered to the functional character of the job it is intended for. Made by a singular automatic method of rolling and welding, this new, advanced tubing, in thin-walled or thick-walled form, is unusually uniform in composition and structure. Pickling and annealing operations are precisely controlled and adjusted to the end application of the tubing. The net result is a fine-grained metal—stainless steel or Inconel—so homogeneous, so completely free from inclusions, so especially treated for severe industrial requirements, that it has far more than an ordinary capacity for service. Any range of finish, interior or exterior, can be applied—a factor all to the good where surface appearance is important.

For these reasons and many more, Trentweld tube, in diameters from ⅛" to 24", is being used today by many top-ranking American manufacturers. Feel free to call on Trentweld engineers—as others have—to put a shoulder to the wheel on any application you have in mind. Draw on their wide experience without obligation. Address—Department 21 or write for the Trentweld Data Bulletin.

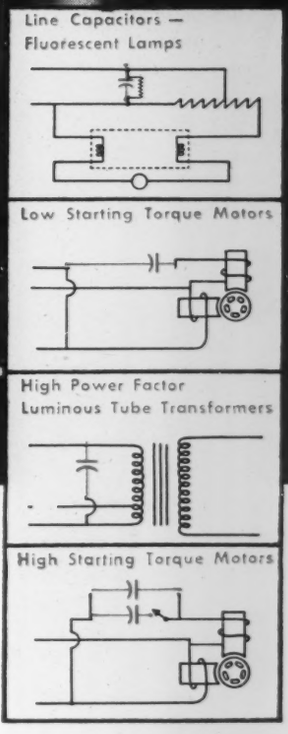
Sales Office—664 N. Michigan Avenue, Chicago 11, Illinois

TRENT TUBE MFG. CO.

TRENTWELD STAINLESS STEEL TUBES

Mill at East Troy, Wisconsin

A-C CAPACITORS



THEIR STRENGTH ADDS "STAYING POWER" TO YOUR PRODUCTS

Capacitors needn't be the weak link in your product—they can have just as much "staying power" as any other component in your equipment.

G-E capacitors have long life. One reason for this is that they are Pyranol* impregnated. Practically all moisture, air, and gas have been withdrawn from the capacitor before the Pyranol treatment takes place. The use of Pyranol also means that these capacitors can operate at high temperatures—up to 75 C (167 F) case temperature. This eliminates one of the main causes of capacitor breakdown.

Casings, available in all standard shapes, are double-rolled, or roll-crimped and soldered, sealing the capacitor hermetically. Plastic bushings, of high dielectric strength, bring out the hot-tin dipped soldered terminals.

If you are building a quality product, here's a quality a-c capacitor that you'll never have to worry about. They're available in a broad range of voltage ratings and capacities. Write for the latest Bulletin GEA-2027C. *Apparatus Dept., General Electric, Schenectady 5, N. Y.*

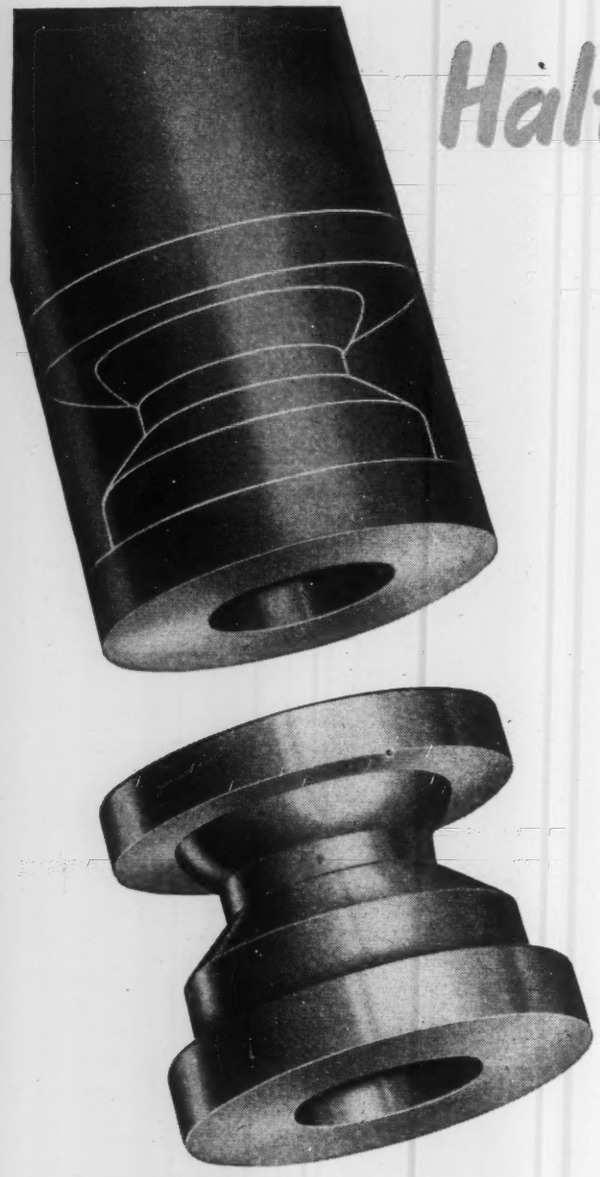
**Reg. U. S. Pat. Off.*

Why Manufacturers Like G-E Capacitors

1. Their price is right.
2. You can get fast shipments.
3. The range of ratings is broad.
4. Designed for small size and light weight in all ratings.
5. Their quality is unexcelled.

GENERAL ELECTRIC

407-111-5700



Half through before you start

when you use tubing for cylindrical parts

NO center hole to drill . . . less stock to machine . . . finish boring often the first step in production! That's why—*in machining any hollow cylindrical or ring shaped part from Timken tubing in sizes up to* 10½" *O.D.*—you're half through before you start!

Timken seamless tubing offers you 16 ways to cut costs and speed production of your hollow cylindrical or ring shaped parts. And often you get an improved finished part too, because Timken seamless tubing is tailored to your individual needs.

On the basis of our experience as the world's largest producer and user of alloy seamless mechanical tubes, our Technical Staff is qualified to help you make better parts—at lower cost. Ask for our "on-your-job" analysis and our free 8-page folder "Timken Seamless Steel Tubes, Finishes and Sizes". No obligation, write today to Steel and Tube Division, The Timken Roller Bearing Company, Canton 6, Ohio.

YEARS AHEAD—THROUGH EXPERIENCE AND RESEARCH

TIMKEN

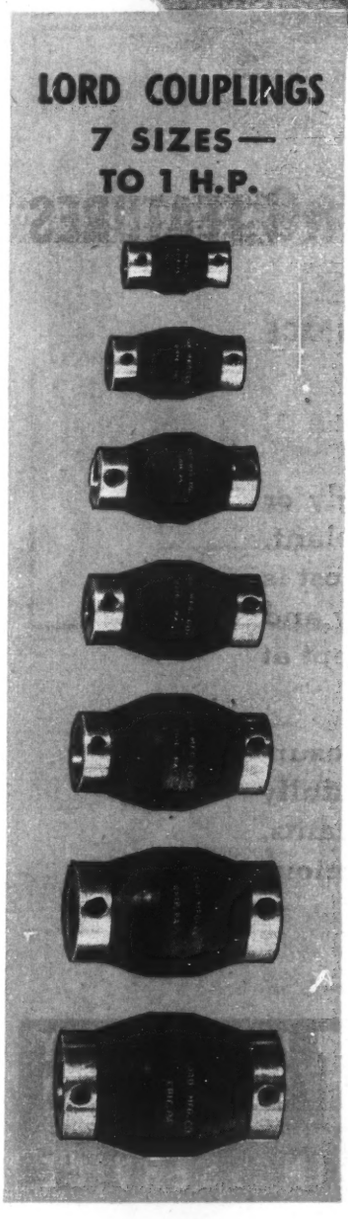
TRADE-MARK REG. U.S. PAT. OFF.

Fine Alloy

STEEL

and Seamless Tubes

Specialists in alloy steel—including hot rolled and cold finished alloy steel bars—a complete range of stainless, graphitic and standard tool analyses—and alloy and stainless seamless steel tubing.



THE true cost of component parts in your product can only be calculated by considering the overall assembly cost. Take couplings as an example. A few cents saved by purchase of inferior couplings often results in slower assembly at a cost much greater than the saving on the coupling itself.

LORD Flexible Couplings are designed to cut those "hidden production costs", and to improve the performance of your product in many ways. Good engineering and intimate acquaintance with production requirements have been combined to create a new conception of coupling performance. Write for your copy of Bulletin 200-C, and see for yourself what LORD Couplings can do to speed production and improve performance.

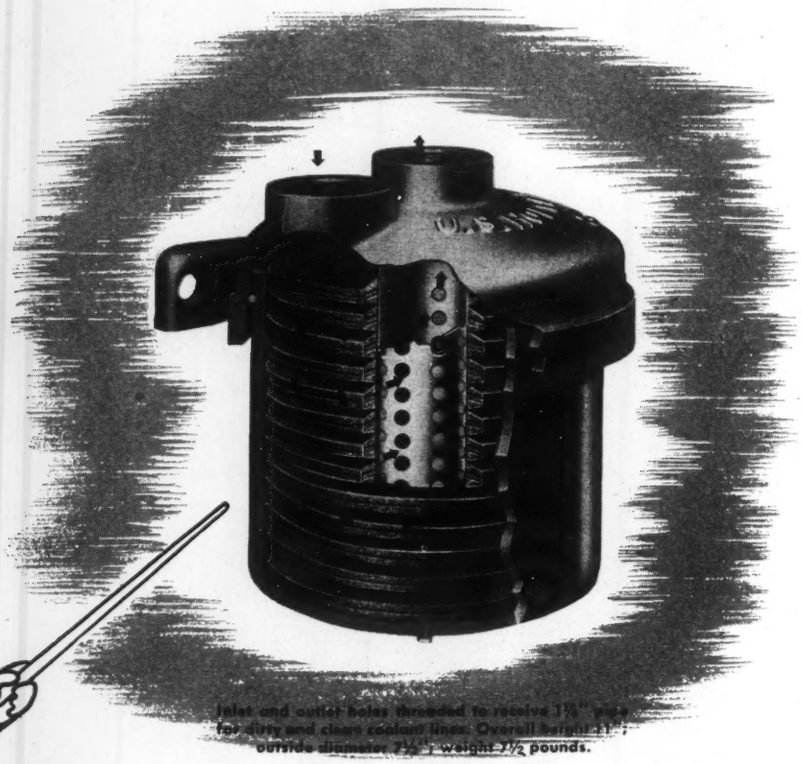
LORD COUPLING AIDS TO PRODUCT AND PRODUCTION

1. **Delivers Smoother Power** by absorbing shaft vibration.
2. **Eliminates Alignment Difficulties** by accommodating more than the usual amount of parallel or angular misalignment.
3. **Quiets Machine Operation** by preventing transmission of noise between shafts.
4. **Increases Life of Bearings And Gears** by cushioning shock and vibrational stresses.
5. **Requires No Maintenance** because there are no moving surfaces to rub, chafe or wear; and therefore, no periodic lubrication is required.
6. **Protects Equipment** by acting as a mechanical fuse. Will break under conditions of extreme overload, disconnecting the driven unit before serious damage is caused.

LORD MANUFACTURING COMPANY, ERIE, PA.

FIELD OFFICES { New York, N.Y. Detroit, Mich. Washington, D.C. Chicago, Ill. Burbank, Cal.
Canadian Representative: Railway & Power Engineering Corp., Ltd., Toronto, Canada.

the NEW HOFFMAN DISC FILTER



Inlet and outlet holes threaded to receive 1¼" pipe for dirty and clean coolant lines. Overall height 11", outside diameter 7½", weight 7½ pounds.

HAS THESE OUTSTANDING FEATURES

- LOW INITIAL COST
- OCCUPIES LIMITED SPACE
- NO MOVING PARTS
- EASY TO CLEAN
- EASY TO INSTALL

The Hoffman Disc Filter can be installed either singly or in units and delivers a continuous flow of clean coolant. Ideal for use where space is limited and low initial cost is a factor. The removable disc element can be quickly and easily cleaned and re-used. Maintenance costs are kept at an absolute minimum.

The Hoffman Disc Filter will remove dirt particles measuring from 3 to 5 micro inches and is being successfully used on screw machines and thread rolling coolants, diesel engine lubricating oils, hydraulic oils and various wash oil applications.

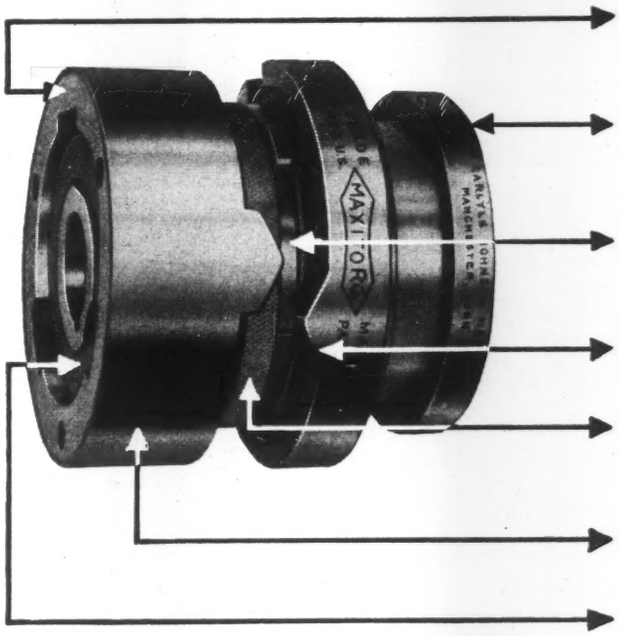
★ SEND FOR LITERATURE

U. S. HOFFMAN MACHINERY CORPORATION
211 Lamson St., Syracuse, N.Y.

COOLANT FILTERS · FILTRATION ENGINEERING SERVICE

Only "MAXITORQ" HAS THESE DISTINCTIVE CLUTCH FEATURES

The Maxitorq Floating Disc Clutch has made a host of new friends during the past year...so many in fact that production facilities, though increased, are strained to the limit. The reason is clear. It is a high quality product that performs its duties with the greatest efficiency. It is tough ...long wearing...simple in construction...yet extremely compact. NOTE THESE VITALLY IMPORTANT FEATURES.



SEPARATOR SPRINGS (patented)
that actually "float" the discs apart...keep them from contact with each other in neutral to prevent drag, abrasion, heating.

SLIDING SLEEVE
with hardened steel wedges riveted in for engaging and disengaging the clutch.

LOCK SPRING
which is raised so that knurled adjusting ring may be turned either for adjustment or disassembly.

CAMS
for automatic overload release. Flame hardened.

ADJUSTING RING
which is manually turned to give desired shifting pressure, or for disassembly.

DRIVING RING CUP
of hardened steel... economical, available to your order.

LOCKING PLATE (patented)
on disc end of each clutch (2 on double types) to lock all discs against tension of Separator Springs.

STANDARD Maxitorqs are for normal requirements.

OVERLOAD RELEASE MAXITORQS are used for high speed automatic machinery which procesess breakable or damageable products.

Available in 8 sizes from ¼ to 15 H. P. at 100 R. P. M.

Send for Catalog No. MD 2

This compact clutch is a complete unit, ready to slip on a shaft and may be ASSEMBLED, ADJUSTED and entirely TAKEN APART without the use of tools ... a valuable feature. All replacement parts are available.

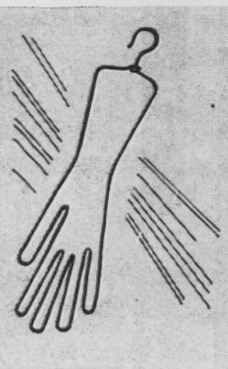
THE CARLYLE JOHNSON MACHINE COMPANY
MANCHESTER • CONNECTICUT

WICK AND SPEN COIL CLINIC

HANDLES MANY "ROUTINE" CASES

Naturally we are proud that the operations of our spring specialists have solved many seemingly incurable production problems. But the majority of the more than 50,000 cases we've handled are "routine".

To us these routine cases are very important because they keep us in practice. The more of these we handle the more efficient our men become in improving spring quality and cutting costs. Here are four of the innumerable "routine" cases we've handled.



DESIGN No. 37433

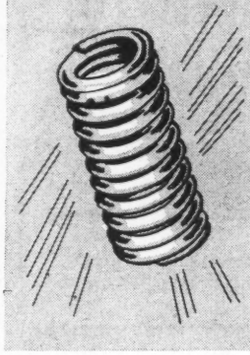
GLOVE DRYER

Hand made in fourteen forming operations, this glove dryer was jigged one finger at a time. Because the length of wire in the form precluded the possibility of automatic machine work, Wickwire toolmakers set up special hand jigs to make this wire form.

DESIGN No. 43711

BICYCLE SADDLE SPRING

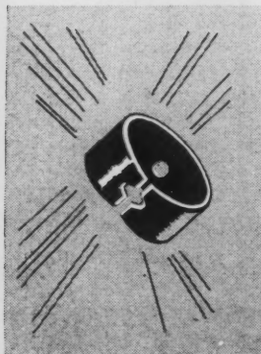
The manufacture of these springs calls for maintenance of correct pitch between spirals and keeping ends concentric for lining up of bolts.



DESIGN No. 40157

VALVE SPRING

Springs for use in high speed operations must possess high fatigue value and be of proper design to prevent failure under stress. Wickwire uses only the finest valve spring steel wire in making these springs.



DESIGN No. 16445

CALIPER RING

This looks like a simple job—and it is. But it requires accurate stamping and forming since the spacing between the ends must be of close tolerance for proper assembly.

LET US SEND YOU THIS NEW CATALOG

This latest edition of "Springs and Formed Wires" is now ready for distribution. In it you'll find valuable data relating to spring performance, technical information, formulae and tables needed to help in proper spring selection. Write today for your FREE copy. Our engineers are at your service to help in designing any conceivable type of spring. We've saved time and trouble for many of our customers. We can do the same for you.

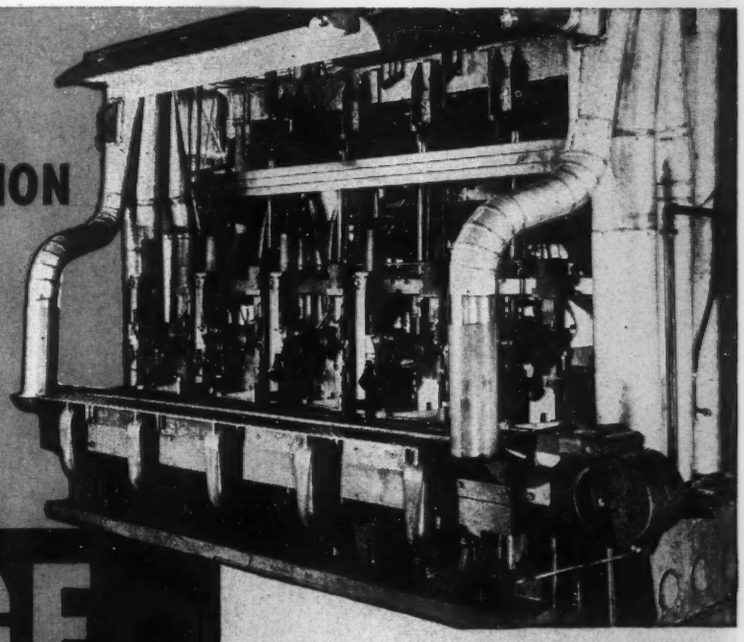
WICKWIRE SPENCER

CF&I Springs

A PRODUCT OF THE WICKWIRE SPENCER STEEL DIVISION
THE COLORADO FUEL AND IRON CORPORATION
Sales Office and Plant—2 New Bond St., Worcester 6, Mass.
General Sales Office—361 Delaware Avenue, Buffalo 2, N. Y.
DISTRICT OFFICES—Boston—Chicago—Denver—New York • The California Wire Cloth Corp.—Oakland 6, Cal.

HERE'S A VERTICAL APPLICATION THAT'S A "NATURAL" FOR THE *New*

ORANGE *Cage Type* NEEDLE BEARINGS

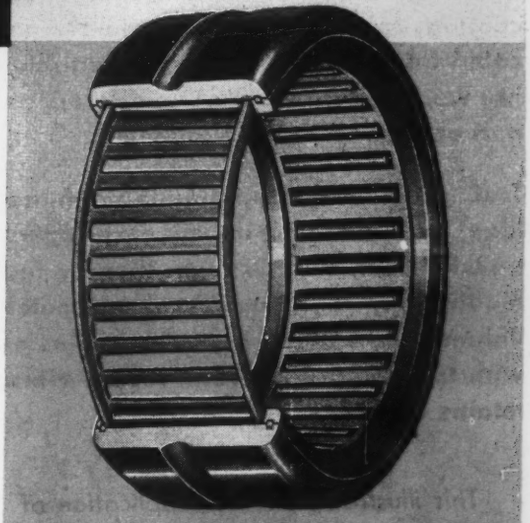


In HARTFORD-EMPIRE BOTTLE MAKING MACHINES, the vital Mold Holding Supporting Mechanism runs on Orange Cage Type Needle Bearings. They are serving in this vertical application with great satisfaction and contributing materially to the long, trouble-free life of these great machines.

DESIGNING ENGINEERS have been waiting for a needle bearing especially adaptable for spindles and high speed applications; that could be used in *vertical* or *overhung* applications; and be less affected by misaligned mountings.

The new Orange Cage Type Needle Bearings are the solution to these punishing operations. The big reason is found in the exclusive cage design which maintains permanent alignment of rollers with precision-ground raceways. As a result, there is no skewing of rollers—less internal friction—smoother, quieter running—longer life hours expectancy. The superior "cage type" advantages make these Orange Bearings ideal for practically all needle bearing applications.

Orange Cage Type Needle Bearings are made in a wide range of standard types and sizes. Send for Engineering Data folder giving full details. Consult our engineers on any application.



● Cross-section shows square-end rollers in coined pockets of free-rolling cage, made of anti-friction, non-ferrous metal. Internal clearances can be controlled to meet exacting specifications. All rollers and raceways "Pentrate" finished.

ORANGE ROLLER BEARING CO., INC.
556 Main Street, Orange, N. J.

ORANGE ROLLER BEARING CO., INC. MD
ORANGE, NEW JERSEY

Gentlemen:

Please send me Engineering Data on new Cage Type Needle Bearings.

Name.....Title.....
Company.....
Address.....
City.....State.....

WOLVERINE TRUFIN gives

. . . as it keeps passengers comfortably cool in Douglas airplanes

The new Douglas DC-4s, as a result of successful tests, will be equipped with cooling units which will keep temperatures in cabin interiors down to a comfortable degree in hot weather. Wolverine Trufin forms an essential part of this recent development.

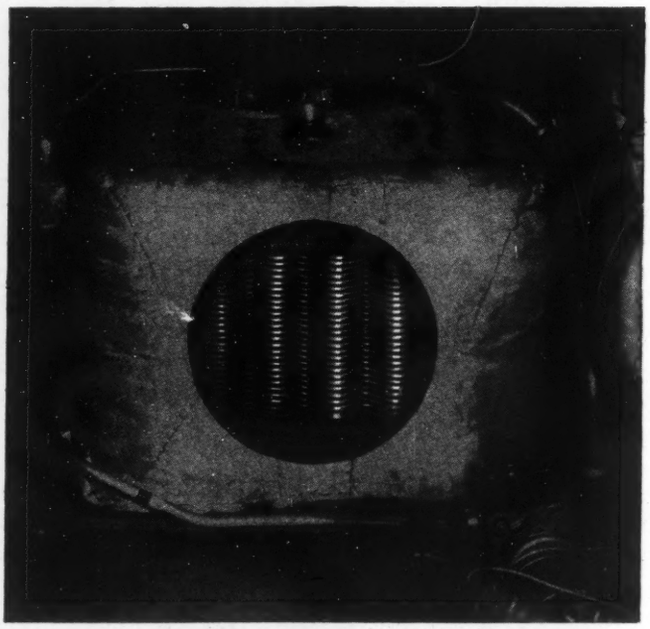
Trufin all-one-piece, aluminum finned tube is ideal for aircraft use in heat exchangers. The heat transfer coefficient is high, thereby reducing the required surface area and ultimately saving volume and weight. Because the fins are integral with the tube itself, Trufin resists vibrations and retains its efficiency.

This illustrates another application of Wolverine Trufin, again demonstrating the high performance values this unique tube delivers in compact space.

WOLVERINE
TUBE DIVISION

CALUMET & HECLA CONSOLIDATED COPPER COMPANY

1411 CENTRAL AVENUE • DETROIT 9, MICHIGAN



Air is sucked into the airplane by a fan and routed through the cooler flowing around the outside of the finned tubing, and then dispersed in the main cabin. In this application, Wolverine Trufin contains a mixture of alcohol and carbon dioxide at a temperature of approximately 100° F below the freezing point of water. This mixture is obtained by dropping dry ice into the tank containing methyl alcohol, and is pumped through the cooler as a liquid. This cooling system appreciably lowers the temperature of the cabin for the passengers' comfort during hot weather.

The cooler has 84 individual pieces of Trufin, each 4 inches long. Two coolers are used in the cooling system.

Solid Quality

Solid Durability

Solid Protection

Solid Beauty

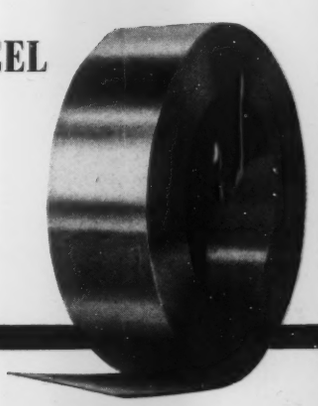
. . . *in modern moldings fabricated of*

Stainless moldings, economically produced in volume with Superior Stainless Strip Steel, provide protection with beauty, brilliance and *permanence.*

Choose SUPERIOR for your moldings fabrication, and get the benefits of *easier handling* through precision composition, exact temper, uniform dimensions and long coil lengths in the right grades for the job!

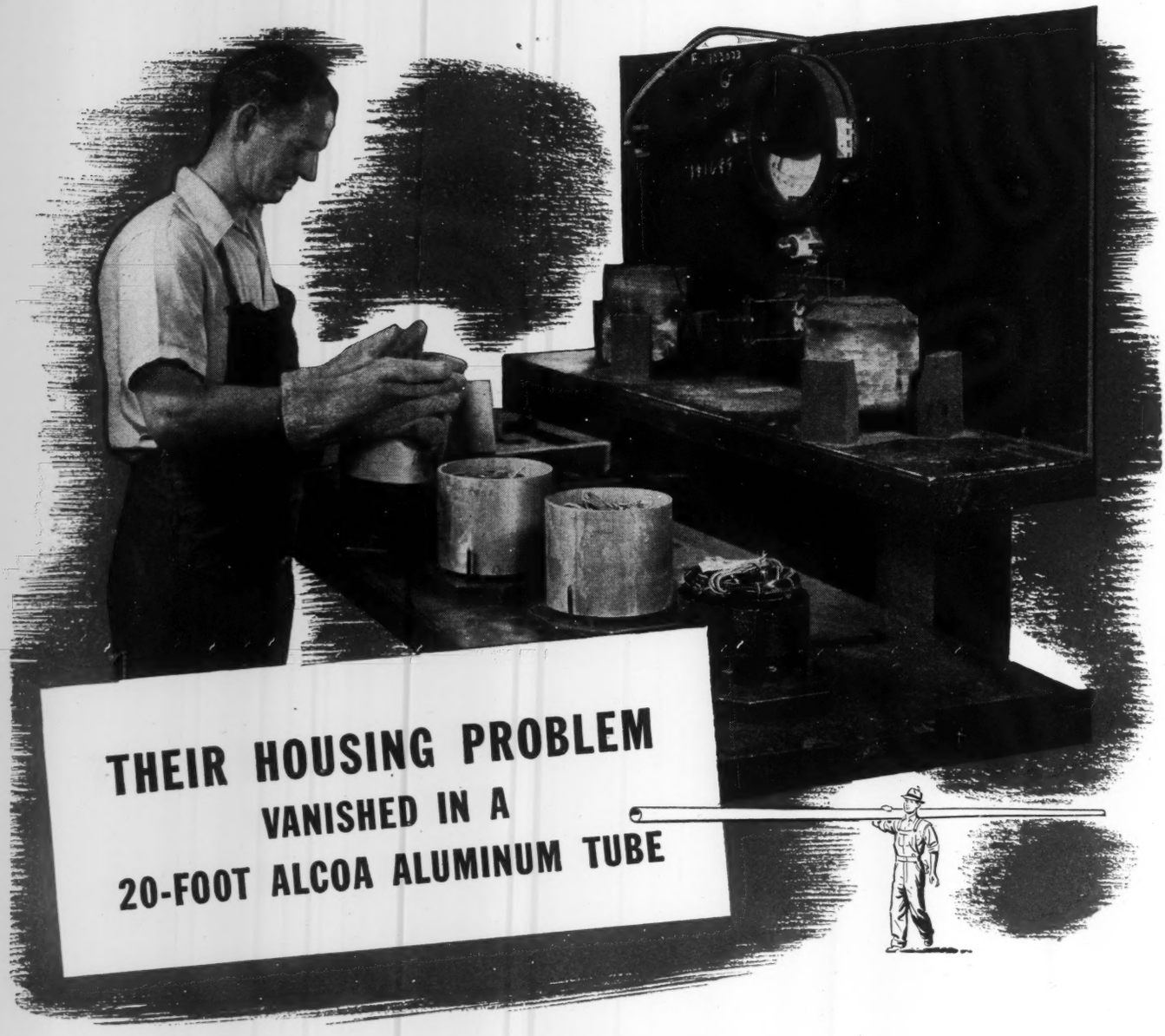
Superior

STAINLESS STRIP STEEL



SUPERIOR STEEL CORPORATION

CARNEGIE · PENNSYLVANIA



One slash with a cutoff saw, a couple of minor machining cuts on the ends of each sawed section, and 20-foot lengths of Alcoa Aluminum Tubes become housings for the electric motors made by Standard Dayton Corporation.

The tubes require no boring. They are merely heat-expanded and slipped over the stators. On cooling, they fit tightly.

What's more, the aluminum housings give a reduction of one-third in motor weight and faster dissipation of motor heat.

When you design a new product, or redesign one already on your assembly line, consider the many commercial forms of Alcoa Aluminum. And our 59 years of aluminum know-how is at your service. ALUMINUM COMPANY OF AMERICA, 1940 Gulf Building, Pittsburgh 19, Penna. Sales offices in leading cities.

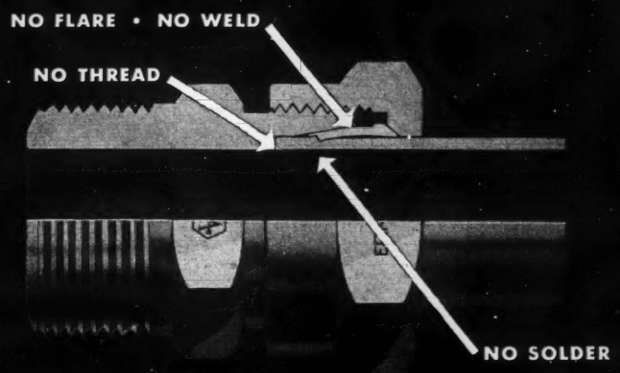
MORE people want MORE aluminum for MORE uses than ever

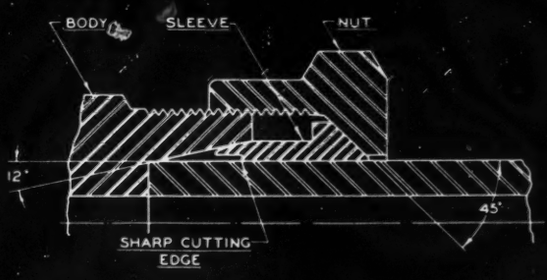
ALCOA FIRST IN ALUMINUM

ALCOA ALUMINUM

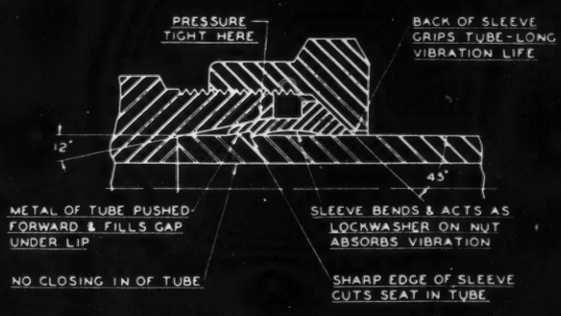
IN EVERY COMMERCIAL FORM

No Other Fitting has this





Tube Inserted in Fitting—
Nut and Sleeve Snug



Nut Tightened In Place

Exclusive Design

MORE and more Contractors and Manufacturers are learning *to their profit*, the benefits of Weatherhead Ermeto Fittings. They solve the mechanical problem of connecting tubing without the necessity of flaring, threading, welding or soldering. This is truly a time-saving fitting.

Connections are quickly made which will, in most instances, hold beyond the burst strength of the tube itself and withstand excessive vibration without loosening the joint.

There is a size and type of Ermeto fitting for practically every application. Can be furnished in O. D. tube sizes from ⅛" to 2" inclusive. Special sizes are available to meet your individual requirements.

Look Ahead with

Weatherhead

THE WEATHERHEAD COMPANY, CLEVELAND 8, OHIO

Cleveland • New York • Detroit • Chicago • St. Louis • Atlanta • Denver • Los Angeles

FREE!

Write today for the fully illustrated Ermeto Catalog and learn how Weatherhead Ermeto fittings can provide dependable connections for hydraulic, air, water or oil lines.

Your nearest Weatherhead office will be glad to consult with you and provide any technical literature.

The most important advance in motor design in 58 YEARS...

Features and improvements demanded most by users

When Westinghouse engineers began designing a postwar motor they abandoned the concept that all motors must be cousins. Instead, they asked electric motor users *what they wanted* in motors . . . features they couldn't buy in any one motor.

These features demanded most by motor users are *all* incorporated in the new Life-Line Motors:

ALL-STEEL PROTECTION. All frames, feet and brackets are HEAVY STEEL. Life-Line Motor stators are far stronger—a new core locking device eliminates rivets.

Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

the New WESTINGHOUSE Life-Line MOTOR

It's completely new . . . it's completely different . . . it wraps up the advances made in "custom-built" wartime motors in a single package!

For 58 years, induction motors have been built fundamentally alike. Differences have been minor . . . improvements gradual. Today, in the new Life-Line, Westinghouse presents a major departure from accepted ideas of standard-motor limitations.

Life-Line, today, offers industry a truly all-steel protected motor. All exposed surfaces are HEAVY STEEL—frames of even the smallest sizes are 3/8" thick.

More compact power is packed in Life-Line. For example, on the 284 frame, size has been reduced 35%, although NEMA mounting dimensions have been maintained . . . starting torques are as much as 134% greater per pound of motor . . . maximum torques as much as 116% more per pound.

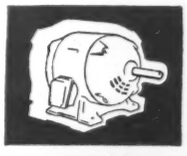
Electrical characteristics have been improved . . . new materials and new winding techniques give increased protection against electrical failure. And sealed, pre-lubricated bearings do away with need for greasing or attention for at least five years!

The Life-Line Motor, as a result, represents the biggest single step forward in design and construction since the invention of the electric motor 58 years ago. Life-Line Motors are now reaching the drives of industry by the thousands, but are not yet available in quantities to meet the unprecedented demand. So, look over Life-Line advantages now with an eye to your future requirements. Your local Westinghouse office can give you full details, or write to Westinghouse Electric Corporation, P. O. Box 2025, Buffalo 5, N. Y.

★ ★ ★

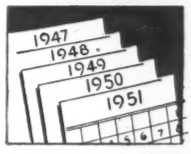
Life-Line Motors are now in production at the new Westinghouse Motor Works in Buffalo, N. Y. This plant is laid out, tooled and equipped to fully utilize newly developed production processes and techniques on a scale hitherto unequalled in the manufacture of electrical motors.

J-21406

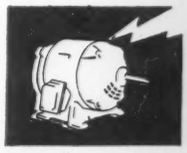


LESS SPACE PER HP. Life-Line Motors occupy less space per horsepower than any other standard motor . . . making it easier to build into machines and install in cramped quarters.

MORE TORQUE PER LB. Life-Line Motors give as much as 134% higher starting torque per pound of motor . . . up to 116% higher maximum torque.



NO LUBRICATION FOR 5 YEARS. Life-Line Motors need no greasing for AT LEAST FIVE YEARS. Bearings are pre-lubricated . . . sealed against dirt and moisture.



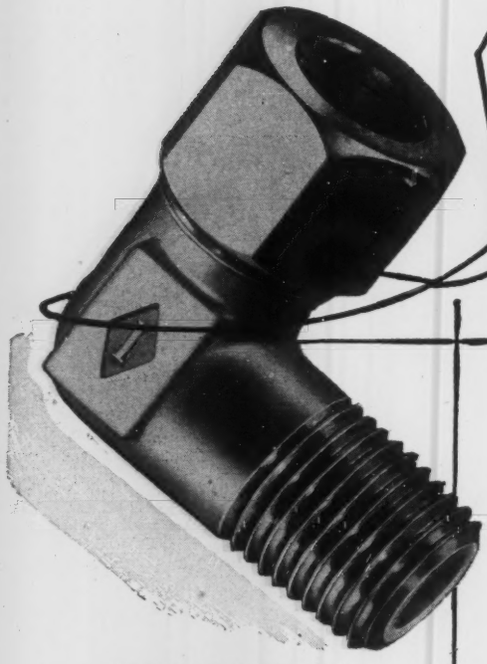
IMPROVED WINDINGS. New insulating materials . . . new coil winding techniques . . . new stator slot designs . . . give the Life-Line new record-setting protection against electrical failures.

NEW QUIET SMOOTHNESS. Life-Line Motors cut vibration and noise to new low limits for standard motors . . . satisfy many "special motor" requirements.

NEW SLEEK LINES. The Life-Line has sleek lines . . . a smooth finish . . . discourages dust and dirt accumulations . . . harmonizes with modern machine and tool design.

Life-Line motors

Now... Finer because they're ☆ Forged



IMPERIAL TUBE FITTINGS
for connecting copper, steel, aluminum and other thin-wall metal tubing.

FORGED FITTINGS ARE STRONGER

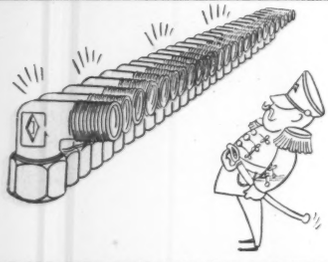
Brass forgings are over 80% stronger than brass castings — that's why forged fittings will withstand higher pressures.

FORGED FITTINGS ARE TOUGHER

Forged fittings stand up better under hard knocks, mechanical shock, and vibration because forging concentrates fiber-like flow line structure of metal at points of stress.

FORGED FITTINGS ARE CLOSER GRAINED

The extremely close-grained structure of forgings assures against blow holes or other concealed defects and against seepage of even hard-to-hold materials.



FORGED FITTINGS ARE MORE UNIFORM

Dimensions of forgings are held within extremely close limits — far closer limits than are possible in the case of castings. This makes fittings easier to install.

DRYSEAL PIPE THREADS

Full length SAE Dryseal Pipe Threads are being incorporated on pipe thread ends. These threads make tight joints without pipe dope; are longer on sizes ¼" and over.

IMPERIAL announces new, finer tube fittings for connecting copper, steel, aluminum and other thin-wall metal tubing. These new fittings have forgings instead of castings on standard elbow and tee bodies and SAE Dryseal Pipe Threads on pipe connections.

The superiority of forged brass fittings has long been recognized. They have been used for hard-to-hold liquids and gases, as in refrigeration, and for work where high pressures are involved. Now, for the first time these better fittings are made available for general industrial applications.

Today, more than ever before, the Imperial Diamond "I" is your assurance of top quality. Write for Bulletin 349.

THE IMPERIAL BRASS MFG. CO., 513 S. Racine Ave., Chicago 7, Ill.

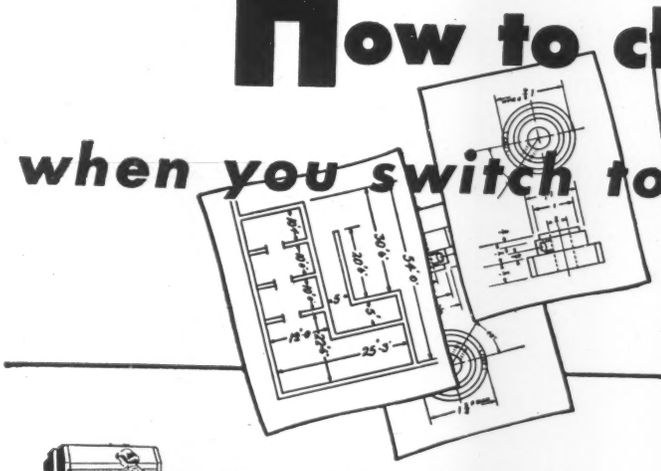
☆ Elbow and tee bodies on Compression, Flared Hi-Duty, Flex and Inverted Flared Tube Fittings are being converted to forgings. Straight fittings made from brass rod.

IMPERIAL

Compression, Flared, Inverted Flared, Hi-Duty, and Flex Tube Fittings • Shut-Off Valves • Needle Valves • Fuel Strainers • Tube Working Tools

How to choose WISELY

when you switch to Black Line Prints



Choose Simple Equipment

When you change to Direct Process Black Line prints, be sure your equipment is simple—easy to operate. Bruning BW Printer-Developers have no complicated mechanism, no unnecessary "gadgets" . . . are compact in size, not bulky or unwieldy. Even the largest BW Printer-Developer requires only one operator—and there is a size of Bruning Printer-Developer for every need. Prints are made in seconds—delivered ready for use.

Get a Wide Variety of Print Advantages

At present, you may be interested only in regular black line prints—but be sure your equipment is versatile enough to care for future needs. With Bruning Printer-Developers, you can make a wide variety of different prints, including BW Film, for salvaging worn or soiled tracings, and BW Colored Line Prints on white or tinted backgrounds (see list below).

Be Sure of *Continuing* Service

With 45 years of experience in analyzing printmaking needs, Bruning is equipped to give you continuing service. When you buy BW equipment, we do not consider it a "one time sale" since our representatives offer everything for the engineer and draftsman and are thus interested in your complete satisfaction.

YOU GET THESE SIX MAJOR ADVANTAGES with the BRUNING BW SYSTEM

1. A versatile, simple method for making black or colored line prints directly from transparent or translucent originals.
2. 45 years' experience in analyzing printmaking needs.
3. A complete direct-line printing process, including white and green tinted papers, thin, medium and card-weight papers, black, red or brown line prints. BW Transparents and BW Film (intermediate prints) to supplement original valuable tracings.
4. A complete line of printing and developing machines to fit every requirement.
5. A continuing service . . . because Bruning sells *everything* for the engineer and draftsman, not just BW equipment. Buying a BW machine is, therefore, not a "one time sale."
6. Continuing research and development in the customer's interest.

FIND OUT WHAT BW PRINTS CAN DO FOR *YOU*... MAIL THE COUPON!

CHARLES BRUNING COMPANY, INC.

Since 1897

NEW YORK	CHICAGO	LOS ANGELES
Atlanta	Boston	Detroit
Houston	Kansas City	Milwaukee
Newark	Pittsburgh	St. Louis
San Francisco	Seattle	

CHARLES BRUNING COMPANY, INC.
4726-30 Montrose Avenue, Chicago 41, Illinois
Gentlemen: I want to know more about Bruning BW Prints and equipment. Please send me information.

Name.....

Company.....

Street.....

City.....*State*.....

GET SET

FOR COMPETITION

USE alliance MOTORS

THE NEW MODEL A shaded pole, induction-type Alliance Fan Motor for speeds from 500 to 1050 R.P.M. operates on 50 or 60 cycles at voltages up to 220, 1/30th horse power, size 4⅝ x 2¾ inches. Porous bronze, oilless-type sleeve bearings. Open or fully enclosed construction. Approx. 8 to 40 oz. in. full load running torque, depending on stack length. Exceptionally quiet. For continuous or intermittent duty. Runs clockwise or counter clockwise—not reversible.

ALLIANCE PHONOMOTORS — POWR-PAKT MOTORS in shaded pole induction and split-phase reversible resistor types rated from less than 1/400th h.p. on up to 1/20th h.p. for powering valves, switches, controls, driving turntables, fans, record changers and automatic devices.

Drive your products to market—use *Alliance Motors* to drive vital component parts. Big advantages for the Alliance Powr-Pakt line are compactness, light weight, versatile performance characteristics, and *mass production* at low cost.

Alliance Powr-Pakt Motors are rated from less than 1/400th h.p. on up to 1/20th h.p. They'll supply just the *right amount of power at strategic points* to impart automatic action, instant control and greater usefulness for your products and processes.

WHEN YOU DESIGN—KEEP alliance MOTORS IN MIND

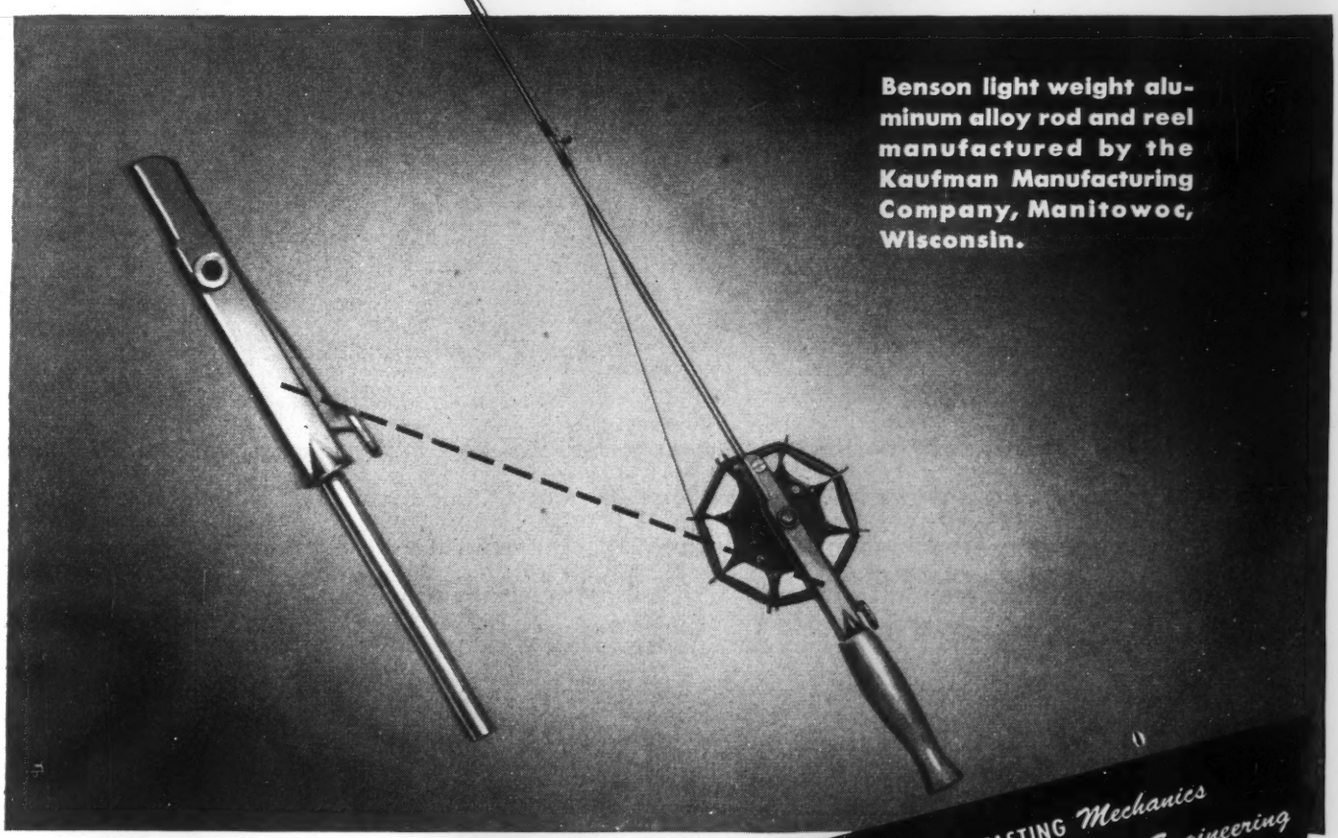
ALLIANCE MANUFACTURING COMPANY • ALLIANCE, OHIO

MADISON-KIPP *Aluminum* DIE CASTINGS

WHERE LIGHT WEIGHT IS ESSENTIAL

The newly designed aluminum alloy rod and reel is spectacular for many reasons, including its extreme lightness. The entire assembly, which includes a die cast handle and brake lever, weighs only 10¾ ounces.

Die castings are utilized in more and more of America's finest products. The advantages of the die casting process are usually pronounced for fishing rod handles or for other more intricate parts if they are required in large quantities.



Benson light weight aluminum alloy rod and reel manufactured by the Kaufman Manufacturing Company, Manitowoc, Wisconsin.

- *Skilled in* DIE CASTING *Mechanics*
- *Experienced in* LUBRICATION *Engineering*
- *Originators of Really High Speed* AIR TOOLS

MADISON-KIPP CORPORATION

210 WAUBESA STREET, MADISON 4, WISCONSIN, U. S. A.

ANCIENS ATELIERS GASQUY, 31 Rue du Marias, Brussels, Belgium, sole agents for Belgium, Holland, France, and Switzerland.

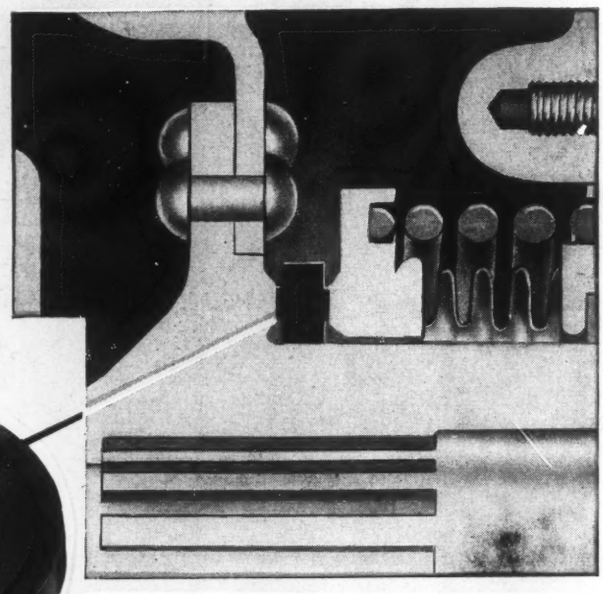
WM. COULTHARD & CO. Ltd., Carlisle, England, sole agents for England, most European countries, India, Australia, and New Zealand.

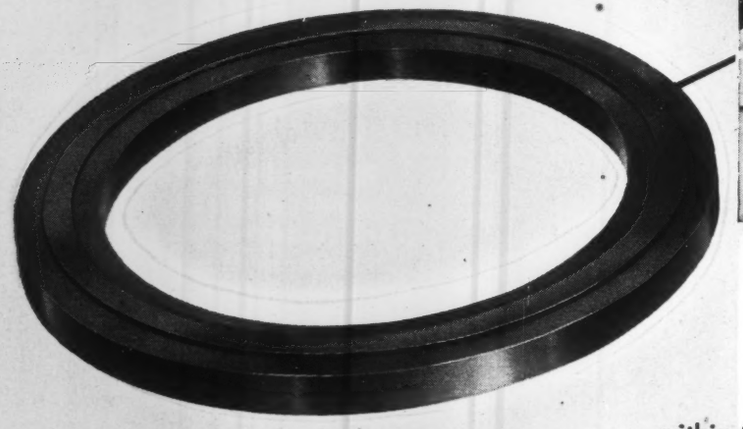
graphitar seal helps

(CARBON-GRAPHITE)

# of gyrol fluid drive unit

AMERICAN BLOWER CORPORATION USES GRAPHITAR SEALS TO INSURE DEPENDABLE PERFORMANCE OF GYROL FLUID DRIVE.



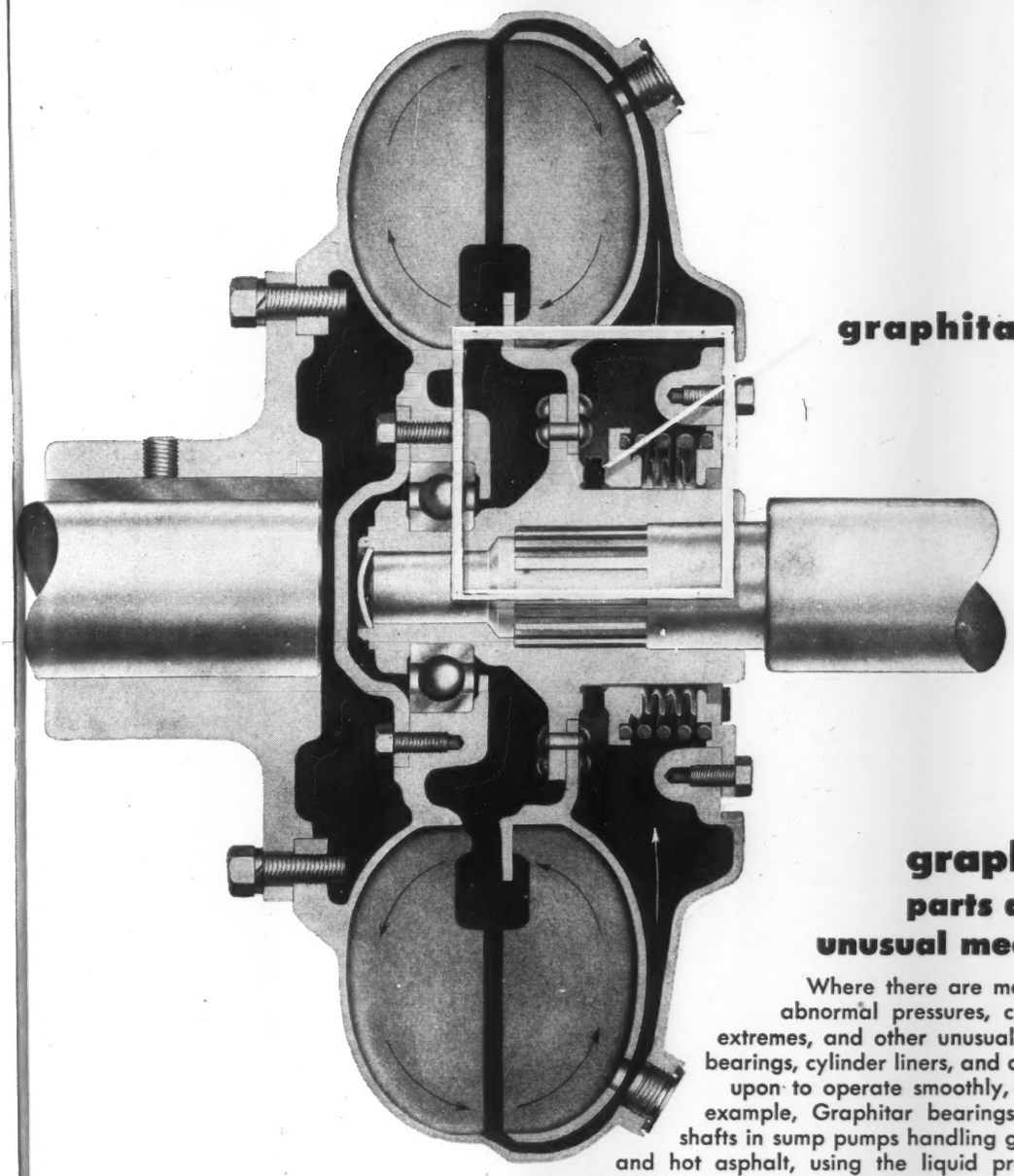


A small Graphitar seal, lapped flat to within 35 millionths inches, helps to produce the dependable performance of the Gyrol Fluid Drive manufactured by American Blower Corp. Installed as shown, the Graphitar seal floats free, seals with no leakage whatsoever, and requires no lubrication because its carbon-graphite composition is self-lubricating. This seal, like all Graphitar parts, affords maximum resistance to friction and wear, it is mechanically strong and it is unaffected by chemical attack and sudden and extreme temperature changes. In similar installations, Graphitar seals assure efficient sealing where operating conditions include pressures up to 60 lb./sq. in. at 350°F. and 1000 ft./min., and temperatures up to 550°F.

THE UNITED STATES GRAPHITE COMPANY

SAGINAW, MICHIGAN

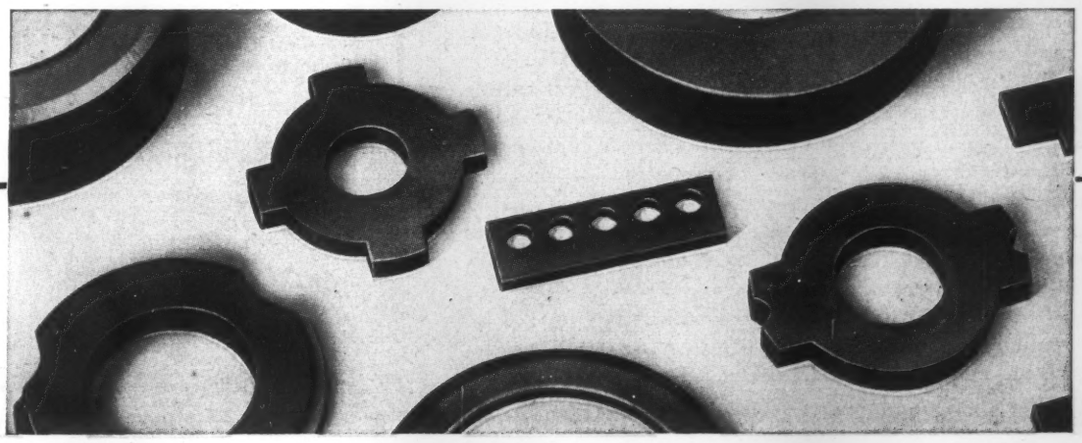
s maintain high efficiency



graphitar seal

graphitar
parts are made to meet unusual mechanical demands

Where there are mechanical problems involving abnormal pressures, chemical attack, temperature extremes, and other unusual conditions, Graphitar seals, bearings, cylinder liners, and other parts may be depended upon to operate smoothly, efficiently, and quietly. For example, Graphitar bearings align and support vertical shafts in sump pumps handling gasoline, alcohol, molten salt, and hot asphalt, using the liquid present as lubricant to insure dependable pumping at pressures up to 200 psi, temperatures to 1000°F., and speeds to 1200 ft./min. The successful applications of Graphitar, in various shapes and with close tolerance dimensions, are too numerous to list—but, if you will send us sketches or descriptions of your products our engineers will be glad to show you where Graphitar parts will improve mechanical performance and save you money. Ask for 44-page catalog.



OF COURSE, it can't be stopped by a human skull—no matter how thick. But exposure must be held within strict limits . . . for X-ray treatment as well as photography. That can be done easily and *accurately* with a modern X-ray machine when it has a timer operated by a Telechron synchronous electric motor.

This is typical of hundreds of applications for these dependable, versatile motors. For over 25 years Telechron has been the largest producer of synchronous electric motors. Telechron engineers—co-operating with the manufacturers of automatic timing, switching, recording, and control equipment—are working out new applications every day. *Perhaps they have the answer to the timing puzzle confronting you.*

Telechron motors can be adapted to a wide range of electric devices. They can be applied as easily to complicated control mechanisms as to the simplest switches. They're self-starting and reach rated speed almost instantly. Operating in perfect synchronism with all commercial frequencies, *they cannot run faster or slower.* Torque ratings are conservative. This—with precision building and Telechron's exclusive capillary oiling system—assures long, trouble-free service. Telechron motors have been used successfully in clocks and timing devices for 25 years—and more. They're Underwriters Laboratories approved. Telechron's *application engineers* will be glad to discuss your needs. Why not call on them? There's no obligation. Just address Motor Advisory Service, Dept. C, Telechron Inc., Ashland, Massachusetts.

see our CATALOG in SWEET'S FILE for PRODUCT DESIGNERS

Telechron Motors Are Now Being Used for:

Stoker, Oil Burner and Temperature Controls
Industrial Process and Cycling Timers
Business Machinery
Medical Devices
Household Appliance Timers
Musical Devices

Telechron
REG. U. S. PAT. OFF.
SYNCHRONOUS MOTORS

The First and Favorite Synchronous Electric Motor

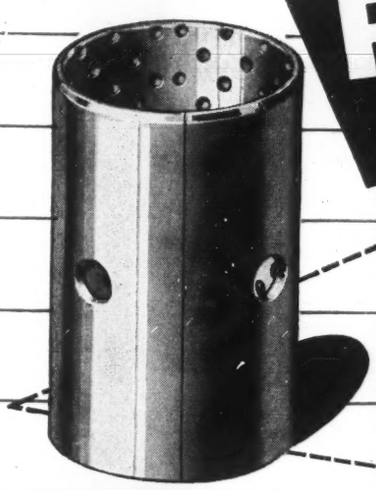
Wichita City Libra

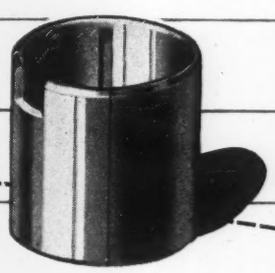
IF THE OLD WAY IS TOO *Slow* OR TOO *Costly*

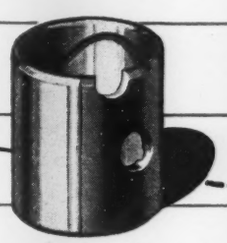
it's time to take your BEARINGS

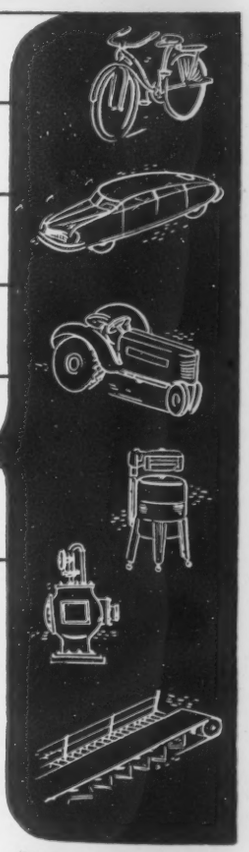
FORMETAL

Superformed BUSHINGS AND BEARINGS









When the performance of your product is not up to expectations, check the bushings or bearings you are using. At no higher cost, you can have FORMETAL bushings or bearings with exclusive qualities which provide the smoother performance and longer life so important to any moving part.

You can reduce costs and improve quality of product through features of FORMETAL bushings and bearings such as these: (1) a higher Rockwell hardness without loss of machinability, (2) a thinner wall can be used which will give the same strength as the heavy wall of an ordinary bushing, (3) custom-made oil grooves, to provide a wiping action of the oil film, can be engineered to the need.

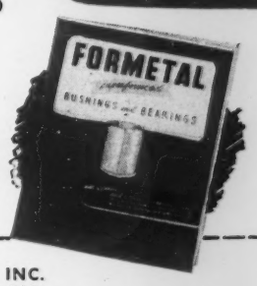
FORMETAL bushings and bearings can be made of bronze, steel, or alloy of your specifications in a wide range of types and sizes. Write for new, free catalog. You will want it for constant reference if you are an engineer, or buyer of bushings and bearings.

also SPACER TUBES

and

SLEEVES..FERRULES..TUBES IN SHORT LENGTHS OF ANY METAL OR ALLOY, CAN BE FURNISHED TO SPECIFICATION

Check your needs for bushings and bearings against the wide range of types illustrated in this compact booklet. Send for it today.



To get your products really rolling *specify...* FORMETAL!

FORM METAL

NATIONAL FORMETAL CO., INC.

ESTABLISHED 1919

Manufacturers of "Superformed" Bushings and Bearings . . . and Spacer Tubes

6604 METTA AVENUE CLEVELAND 14, OHIO

Offices in DETROIT • CHICAGO • NEW YORK • LOS ANGELES • INDIANAPOLIS

NATIONAL FORMETAL CO., INC.
6604 Metta Ave., Cleveland 14, Ohio

Please send free copy of your new catalog.

NAME_____

COMPANY_____

ADDRESS_____

CITY and STATE_____

For machine designers' ready reference...

this Pulsolator Engineering Manual on a dependable control feed lubrication system. See how automatic, adaptable and versatile Pulsolator is — what it will mean to the life and the production of the machine you're designing.

Every machine designer should know about Pulsolator and its easy-to-understand manual that makes it possible to build into your design all the advantages and improved features of this system.

Here's what you need to know about the pumping units, the feeders and the "life lines" that will lubricate your machine. And just in case there's any question on the type of system best suited to your particular job, ask a Rivett engineer to go over the details with you. Send for your copy today.

★ SUPERB ★

OIL RESISTANCE

is only one of Hycar synthetic rubber's unusual and valuable properties. Others are listed in the box at the right.

But most important, these properties may be had in an almost limitless number of combinations, each designed to meet specific service conditions of the finished Hycar part.

Our files contain more than 5000 recipes for Hycar compounds—each compound engineered to do a certain job. Parts made from HYCAR have seen service in *every* industry, giving long life, dependability, and economical operation.

That's why we say, ask your supplier for parts made from Hycar. Test them in your own application, difficult or routine. You'll learn for yourself that it's wise to use HYCAR for long-time, dependable performance. For more information, please write Department HN-2, B. F. Goodrich Chemical Company, Rose Building, Cleveland 15, Ohio.

CHECK THESE SUPERIOR FEATURES OF HYCAR

1. *EXTREME OIL RESISTANCE — insuring dimensional stability of parts.*
2. *HIGH TEMPERATURE RESISTANCE—up to 250° F. dry heat; up to 300° F. hot oil.*
3. *ABRASION RESISTANCE—50% greater than natural rubber.*
4. *MINIMUM COLD FLOW—even at elevated temperatures.*
5. *LOW TEMPERATURE FLEXIBILITY—down to —65° F.*
6. *LIGHT WEIGHT—15% to 25% lighter than many other synthetic rubbers.*
7. *AGE RESISTANCE—exceptionally resistant to checking or cracking from oxidation.*
8. *HARDNESS RANGE—compounds can be varied from extremely soft to bone hard.*
9. *NON-ADHERENT TO METAL—compounds will not adhere to metals even after prolonged contact under pressure. (Metal adhesions can be readily obtained when desired.)*

Hycar

Reg. U. S. Pat. Off.

LARGEST PRIVATELY PRODUCED BUTADIENE TYPE

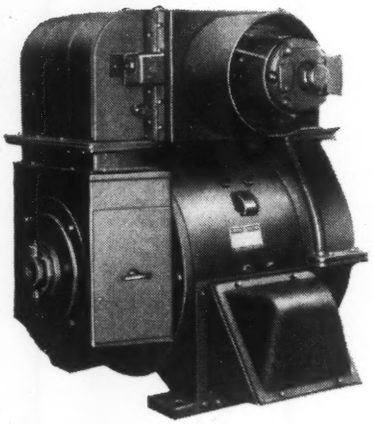
American Rubber

B. F. Goodrich Chemical Company

A DIVISION OF THE B. F. GOODRICH COMPANY

DESIGNER'S Digest

IT'S NEW!



VERSATILE D-C POWER for DIRTY JOBS!

G-E announces new totally enclosed, unit-cooled d-c motor...10-200 hp!

G-E UNIT-COOLED D-C MOTOR DATA

RATINGS

10-75 hp adjustable speed.
50-200 hp at 1150 rpm.

TEMPERATURE RISE

55 degrees C (Class A insulation, 40 degrees C ambient at 3000 feet altitude or less. Class B insulation is also available.)

WINDINGS

Shunt, stabilized-shunt, and compound types for different starting loads.

CONSTANT SPEED

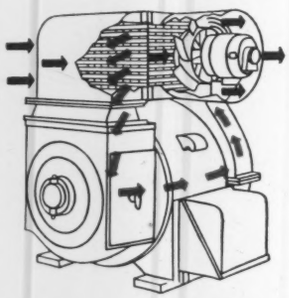
Limited to 25 to 100% speed increase by field control.

ADJUSTABLE SPEED

Speed increases of 300 to 600% of basic speed.

HOW A UNIT-COOLED MOTOR IS VENTILATED

The unit cooler, mounted on top of the motor, is a surface cooler of the "air-to-air" type. Clean warm air (blue arrows) is pulled from the totally enclosed motor by a shaft-driven fan and forced through the cooler. Cool outside air (black arrows) is drawn into the cooler by a separate motor-driven blower to absorb heat from the internal air stream. For a more detailed description, check Bulletin GEA-4469.



Once again G.E. leads the way with a tough yet versatile d-c motor for the dirtiest jobs in industry. This d-c unit-cooled motor withstands atmospheric conditions intolerable to an open or partially-enclosed motor. Dirt, dust, metal particles, and oil are *sealed out* because this motor contains its own totally enclosed ventilating system. Without duct work, piping or air-filters, your important drive motors run smoothly and reliably. Besides, you get all the benefits of versatile d-c motor power. Note these big advantages:

MACHINES STAY ON THE JOB LONGER

No air-borne material can get to the operating parts of this G-E unit-cooled motor. Windings, brushes, and brush riggings stay clean. Motor failures are reduced — machine output increased.

MOTOR PERFORMANCE IS MORE EFFICIENT

The high thermal efficiency of the unit-cooler makes possible for the first time a totally enclosed, direct-current machine in larger sizes with the high performance standards of the open motor. Power consumption is less than that of a conventional fan-cooled motor, particularly where a wide speed range is employed.

MAINTENANCE COSTS STAY DOWN

Large end-shield openings, fitted with easily removable gasketed covers, permit ready access to commutator, brushes, and brush rigging. Bearing-lubricant fittings are also easy to reach.

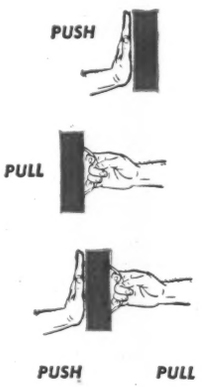
INSTALLATION COSTS ARE LESS

G-E unit-cooled motors have the same mounting dimensions as G-E open (dripproof) and splashproof motors in the same ratings. Being a self-contained unit, auxiliary ventilating fixtures are eliminated.

GENERAL ELECTRIC

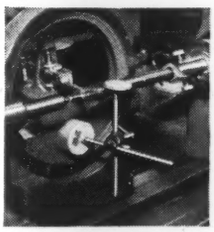
TIMELY HIGHLIGHTS ON GE PRODUCTS

0.9 to 97 lbs. *of push and pull!*



Have you a machine operation where a pushing or pulling motion is required? G-E solenoids can do either or a combination of both. These self-contained, sturdily-built units give long reliable service. Maximum voltage for all types is 600; 60 to 25 cycles and d-c. Stroke lengths from ¾ to 3 inches are available. Push or pull forces range between 0.9 and 97 pounds continuous duty. There are 10 a-c and 7 d-c sizes available to cover this range. G-E solenoids designed for a-c can be used on d-c applications by adding cutout switches. For further information check GEA-2080 on coupon.

STAYS "PUT"... without Clamps or Screws!

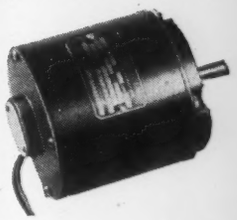


How can you use this G-E magnetic stand? You place the base on a steel or iron surface (table top, machine tool surface, or wall) and it stays "put" without clamps or screws. You can then attach test fixtures, dial indicators, and other instruments to the rod. Normal vibration will not cause it to "creep" out of alignment. To make minute adjustments in the location of the stand, you merely push its base or tap it slightly with a mallet. Stand is 8 inches high; base, 2½ inches in diameter. Check Bulletin GEA-4332 on coupon.

MORE "KNOW" MEANS BETTER "DO"!

To help train new technical personnel, and make supervisory and production men's jobs mean more, G.E. offers this 12 part talking slide film, prepared to teach even non-technical personnel the elements of electronics. This easy-to-understand course in industrial electronics is "packaged" so that sessions can be successfully conducted by "home-talent" instructors. You furnish the instructor, meeting place, projector and record player. Everything else is in the kit. Complete with 12 slide films and records, 300 review books, instructor's manual and carrying case, price of the kit is $100. Call your local G-E office, or order direct from *Apparatus Dept., Sect. 668-53, General Electric Company, Schenectady 5, N. Y.*

TO MEASURE LOW RPM *here's a new a-c "tach"!*



G.E. has developed a small, self-excited a-c tachometer generator, Type SMY-54, designed specifically for low speed operation. It has a speed range of 10 to 1000 rpm.

In this new a-c tachometer, there are no brushes and, consequently, no voltage inconsistencies . . . even at speeds as low as 10 rpm. It is not necessary to use large contact rolls to obtain speed amplification. Moreover, the light weight and small size of the contact roll which can be used with this tachometer enhance its usefulness in applications where space is limited and where contact roll pressure must be kept to a minimum (in extruding metal alloys and plastics, for example).

The G-E Type SMY-54 tachometer is wired to a voltmeter which can be calibrated either in inches per minute or in revolutions per minute. The instrument may be mounted apart from the generator to be within the normal range of vision of the machine operator. A recording instrument may also be added to provide a graphic record of machine speed. For complete details, check Bulletin GEA-4324 on the coupon.

G.E. can supply this special scale for use with the Type SMY-54 tachometer. It makes possible very accurate measurements at low speeds, without sacrifice of wide speed range.

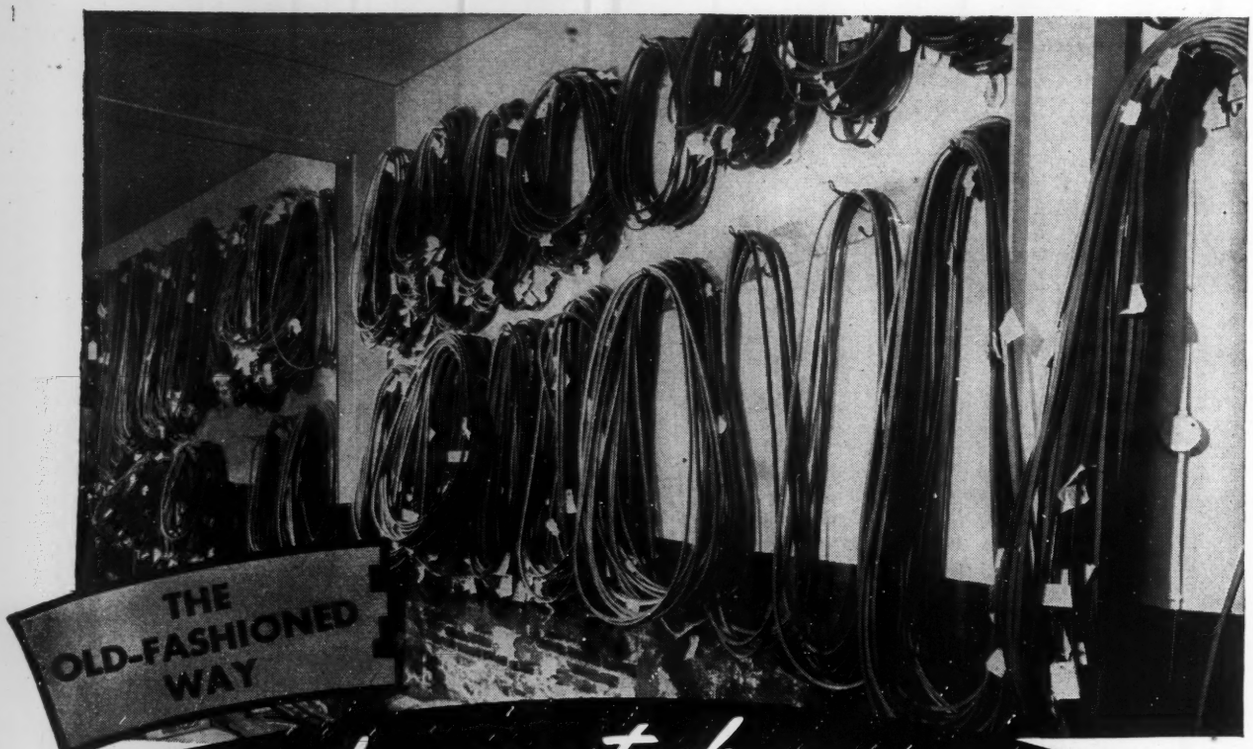
TO GENERAL ELECTRIC COMPANY
Section C668-53 Schenectady 5, N. Y.

Please send me the following bulletin(s):

GEA-4469 — Unit-Cooled Motors . . . . . _____
GEA-2080 — Solenoids . . . . . _____
GEA-4332 — Magnetic Stands . . . . . _____
GEA-4324 — Tachometers . . . . . _____

Name _____
Company _____
Street _____ State _____
City _____

CONSULT YOUR SWEET'S! You'll find "everything electric" for machinery manufacturers in the General Electric section.



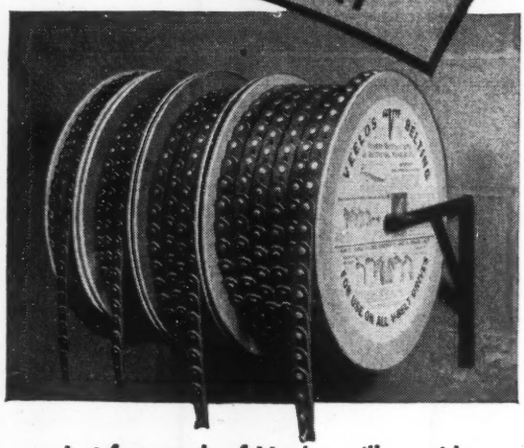
How do you stock your V-belts?

WHY stock a costly and confusing assortment of endless V-belts when you need only a few reels of Veelos, the link V-belt? With only four sizes of Veelos you can make up 316 standard sizes of endless belts. With Veelos, storing spare sets of belts for individual drives becomes outmoded. Expensive, wasteful belt inventories are eliminated . . . deterioration of spare V-belts is ended.

Veelos on reels assures a neat, orderly stockroom. Space is saved. Paper work is reduced. Any desired length of V-belt is always available. Veelos is made in all standard widths, fits all standard grooves, is packaged on standard 100-foot reels.

Veelos sales engineers are located in all principal cities; over 300 distributors throughout the country.

THE MODERN WAY



Just four reels of Veelos will provide 316 sizes of endless V-belts.

VEELOS
THE LINK
V-BELT

Adjustable to any Length
Adaptable to any Drive

MANHEIM MANUFACTURING & BELTING CO.
MANHEIM, PENNSYLVANIA

Tested • Proved • Adopted . . . by American Industry

Magnet cures headache

Extra values through

JACK & HEINTZ

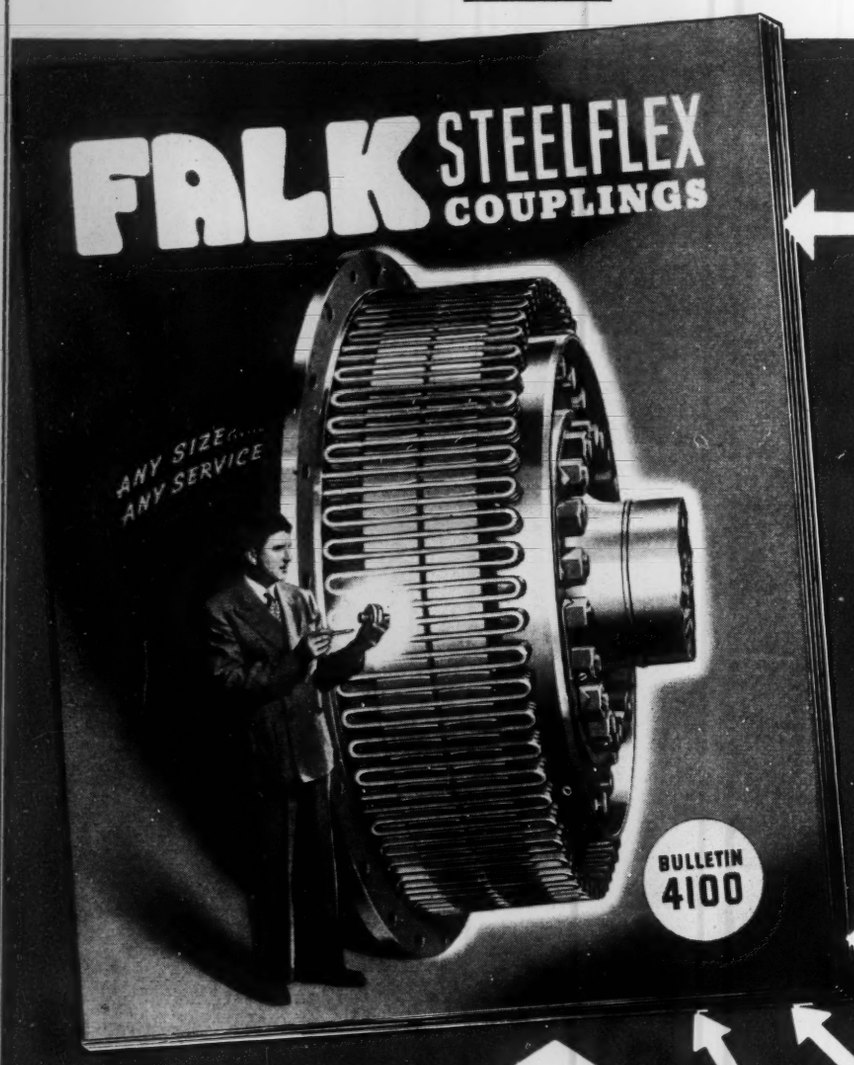
Mass Precision

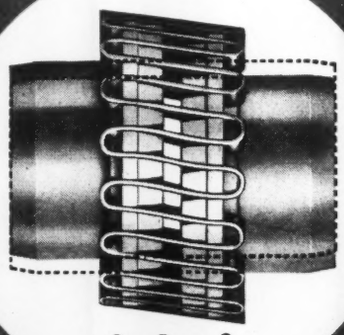
Magnetizing of Magnetos usually takes five operations: (1) assemble magneto, (2) adjust bearings, (3) disassemble magneto, (4) magnetize rotor, (5) reassemble magneto. Operations (3) and (5) were production headaches. These were eliminated by Jack & Heintz engineers who developed a giant magnetizing device by which the rotors are magnetized through the magneto frame . . . *after* assembly. Result: higher quality and faster production of urgently-needed Eisemann magnetos.

Achievements of Jack & Heintz *mass precision* such as this are creating extra values in magnetos, electric motors, bearings, refrigeration compressors and aircraft accessories *today* and in revolutionary developments for *tomorrow.*

JACK & HEINTZ PRECISION INDUSTRIES, INC., ***Cleveland 1, Ohio***

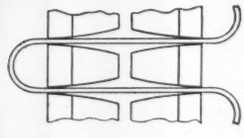
No Ad is large you All the details of





See Page 9

It shows and tells you how the movement of the grid in the lubricated grooves comes into full play when parallel misalignment is involved. The misalignment is accommodated while still permitting full functioning of the grid-groove action of the coupling in absorbing shock and damping vibration. Also graphically shown on this page is the manner in which this Falk grid-groove design acts to accommodate angular misalignment and free end float.



See Page 7

On this page you will note how the grooves provide a slot for a grid member made of chrome alloy steel with an elastic limit of 180,000 pounds per square inch . . . an ultimate strength of 220,000 pounds per square inch, in addition to other features of the grid-groove design.

Send for This Book and *Get All the Facts!*

Falk Steelflex Couplings are designed to meet the needs for couplings for *any size* and *any service*. This book contains complete load classification tables, rating specifications and formulas for easy selection of Falk Steelflex Couplings for motor and turbine drives or engine drives. It also contains information on Falk flexible coupling for special service or dual-purpose applications. Send for it today.

TORSIONAL RESILIENCE

See Page 8

ALL STEEL CONSTRUCTION

See Page 7

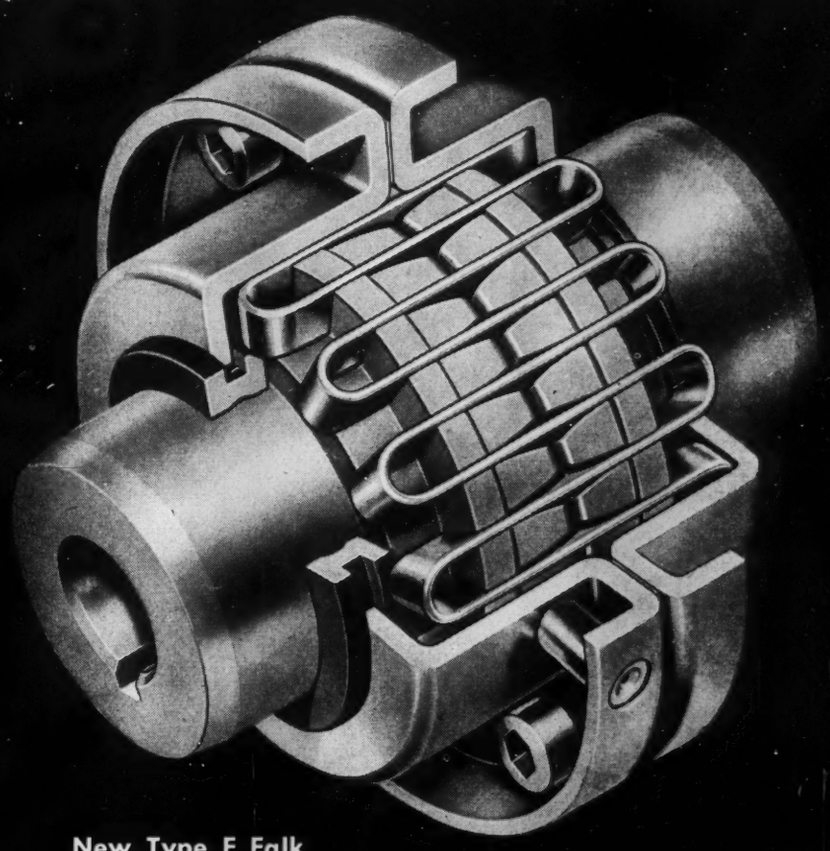
enough to give FALK Steelflex Couplings

● Falk Steelflex Couplings are the development of a company whose experience in gear design and power transmission dates back to 1892.

This experience has enabled Falk to produce a coupling that transmits power smoothly, dampens vibration, reduces shock, and cushions peak loads between the driving and driven member.

The Falk Grid-Groove design is the secret of the success of Falk Steelflex Couplings. It provides flexibility and torsional resilience to a degree not found in other couplings of this type. It provides the utmost compensation for both angular and parallel misalignment, also for free end float. This unusual combination of features has solved many otherwise tough coupling problems.

Falk Steelflex Couplings may be used in either a vertical or horizontal position. A new wide shoulder seal ring keeps the cover in position and protects against dust, dirt and loss of lubricant.



New Type F Falk Steelflex Coupling

It's the Grid-Groove design of Falk Steelflex Couplings that protects connected machinery from damaging shock and vibration, compensates for angular and parallel misalignment and provides torsional resilience.

THE FALK CORPORATION
MILWAUKEE 8 WISCONSIN

For over fifty years precision manufacturers of Speed Reducers . . . Motoreducers . . . Flexible Couplings . . . Herringbone and Single Helical Gears . . . Heavy Gear Drives . . . Marine Turbine and Diesel Gear Drives and Clutches . . . Steel Castings . . . Contract Welding and Machine Work.

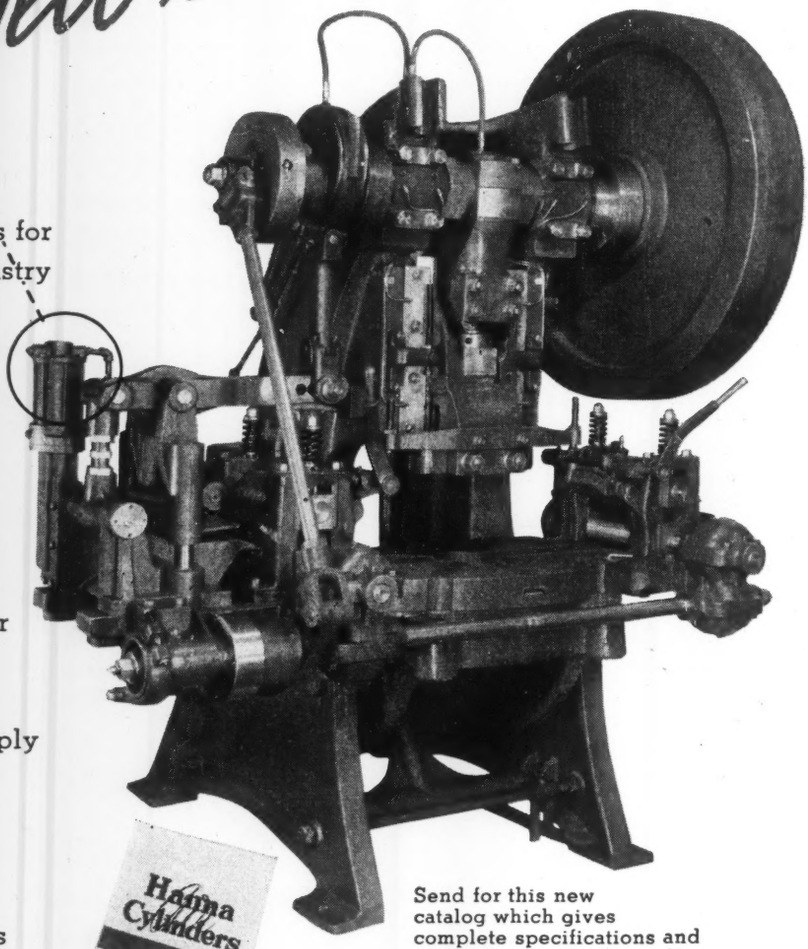
District Offices, Representatives, or Distributors in principal cities.

FALK

. . . a good name in industry

Another Job for Hanna Air Cylinders

"nerve center" for this Littell scrap cutter



JUST one of the 1001 uses for Hanna Air Cylinders in industry is the job this one performs on the Intermittent Scrap Cutter, illustrated at the right. This efficient cutter manufactured by the F. J. Littell Machine Company, depends on its Hanna Air Cylinder to act as a "nerve center" to actuate the cutter through a rack and pinion and an eccentric.

Hanna Air Cylinders supply safe, smooth, dependable power and control at low cost in countless industrial applications. Have you investigated the advantages they offer you?

Send for this new catalog which gives complete specifications and operating information on Hanna Air Cylinders. Just ask for Catalog No. 234; it's free.

Hanna Engineering Works

HYDRAULIC AND PNEUMATIC EQUIPMENT . . . CYLINDERS . . . VALVES . . . RIVETERS

1765 Elston Avenue, Chicago 22, Illinois

Above: Centrifugally cast monel metal plating roll being finish-machined at Shenango-Penn.

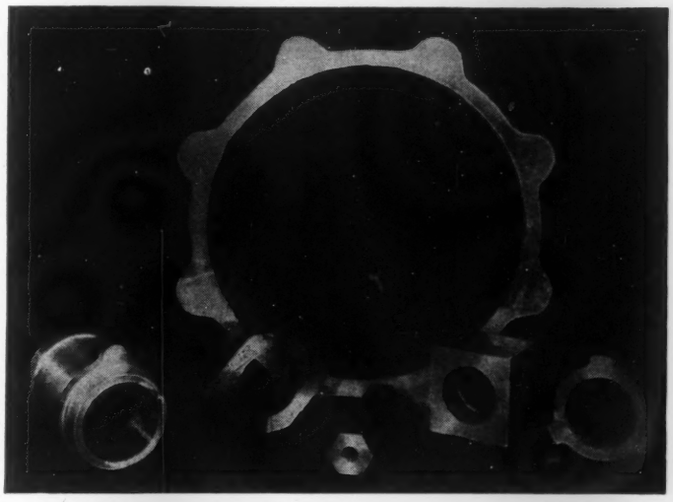
Below: These shapes, all centrifugally cast, show that Shenango-Penn process is not limited to shapes of simple circular section.

VIRTUALLY any engine, machine, or unit of equipment requiring symmetrical parts can be improved by using Shenango-Penn centrifugal castings instead of ordinary castings. This is true because, metal for metal, parts produced the Shenango-Penn way are measurably superior in tensile strength, density, hardness, and uniformity. They have finer grain structure, are better able to withstand friction, abrasion, corrosion, and all kinds of stresses.

These are not mere "laboratory" differences of meager value. They are distinct advantages that time and again have resulted in stronger, more durable, better performing products for Shenango-Penn customers.

Applying Shenango-Penn centrifugally cast parts is also a good way to reduce costs. The castings require less machining, saving time and metal. There are no sand inclusions; no blow holes to contend with. Superior, more uniform grain structure makes it easier, less expensive to attain the desired finish!

Shenango-Penn has complete, modern facilities to carry your machining requirements as far as you wish, can supply either rough castings, semi-finished or completely machined precision parts to your specification.



FREE BULLETIN No. 143

Ask for this free bulletin. It gives full information on the complete range of available ferrous and non-ferrous alloys, physical and chemical properties, recommended uses, and other data helpful in making a good engine or machine still better.

SHENANGO-PENN

SHENANGO-PENN MOLD COMPANY
1262 WEST THIRD STREET • DOVER, OHIO
EXECUTIVE OFFICES: PITTSBURGH, PA.

ALL BRONZES • MONEL METAL • ALLOY IRONS

A real space-saver . . .

This small, sturdy, lightweight cooler for oil, water and other fluids

ROSS

Where space is at a premium, and heat removal must be accomplished with a small, lightweight cooler, you'll find the Ross Type "BCF" design ideal in every respect.

For instance, consider Diesel, hydraulic press, reduction gear, thrust bearing or turbine installations. The "BCF" has proved itself so perfectly suited and so outstanding in performance that machinery builders everywhere are including it as original equipment. In their judgment, no other cooler measures up in compactness, high heat transfer rate, sturdy non-ferrous construction, low maintenance, easy inspection or cleaning, flexible mounting provisions.

. . . BUT, MOST IMPORTANT TO YOU, each "BCF" cooler is individually assembled from standard parts. Through this Ross feature you have the combined benefits of meeting your requirements EXACTLY, as well as saving through mass production.

ROSS HEATER & MFG. CO., INC.

Division of American Radiator & Standard Sanitary corporation

1429 WEST AVE. BUFFALO 13, N. Y.

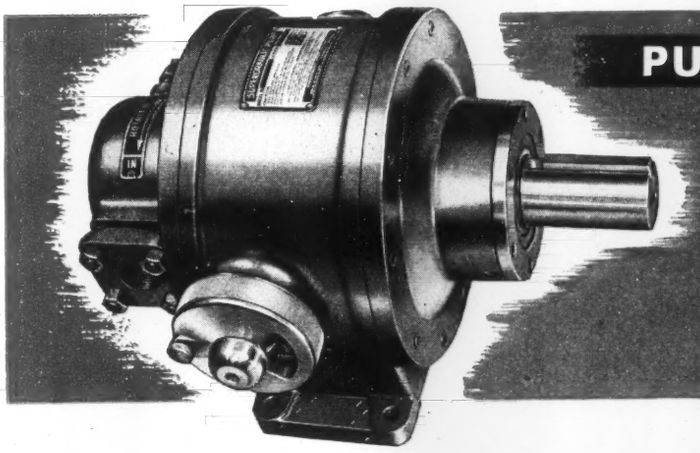
ROSS EQUIPMENT IS MANUFACTURED AND SOLD IN CANADA BY HORTON STEEL WORKS LTD., FORT ERIE, ONTARIO

DO YOU HAVE Bulletin 4922?

You'll find it very informative in solving your smaller cooler problems. Write today for free copy.

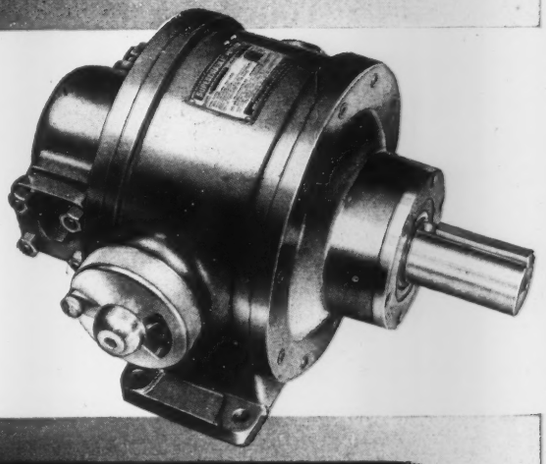
Every One a Star!

Superdraulic pumps, motors, transmissions, relief valves, check valves, 4-way valves, power units, and high-pressure couplings enable you to utilize hydraulics at its best. Following are descriptions of principal Superdraulic units:



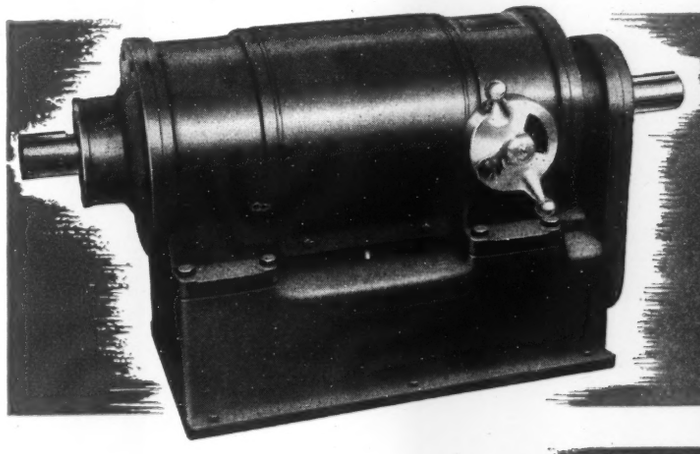
PUMPS

High-pressure hydraulic pumps—5000 psi, 40 hp with 0 to 12 gpm at 1200 rpm or 0 to 17 gpm at 3500 psi. Here is giant power in a midget hydraulic pump only 10½" in diameter. Instantly responsive finger volume control gives variable volume and reversible flow. Also available in constant delivery types only 9" in diameter with identical rating. Ideal power for presses, plastics machinery—wherever hydraulic power is required and where space is at a premium.



MOTORS

Triport hydraulic motors—26½ gpm at 3500 psi input at 1200 rpm, 19 gpm at 5000 psi input at 1200 rpm. Giant horsepower and giant torque in hydraulic motors of midget size. Sixty-six power strokes per revolution provide high starting torque and turbine-smooth output. Up to 47 hp with torque range up to 200 lbs. ft. in either type. Ideal for driving all types of machinery.



TRANSMISSIONS

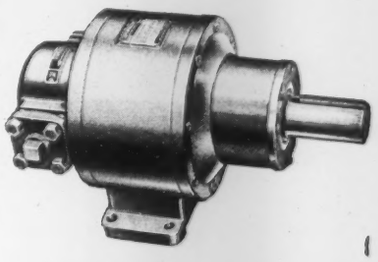
Million-speed hydraulic transmissions. Combining the famous Superdraulic variable delivery pump and triport motor, these units provide infinitely variable, turbine-smooth power in minimum space. Up to 200 lbs. ft. output torque, 0 to 1200 rpm (reversible), up to 30 hp output. A perfect transmission for countless industrial applications.

It is almost certain that in their long experience, Superdraulic engineers have been called upon to solve hydraulics problems similar to yours. They would welcome an opportunity to sit down with you and discuss the application of hydraulic power to your products.

In the meantime, send for complete technical descriptions of the above Superdraulic units.

JUNIOR PUMPS

The Superdraulic Junior Pump, as its name implies, is practically a duplicate of the 40 hp Superdraulic constant delivery pump on a reduced scale. A single bank of eleven plungers delivers 3 gpm at 1800 rpm and 2 gpm at 1200 rpm. This pump is furnished for 5000 psi continuous duty operation.



Superdraulic Corporation

HYDRAULIC PUMPS • MOTORS • TRANSMISSIONS • VALVES

MILLER AT FORD RD. • DEARBORN, MICHIGAN

A PART OF SQUARE D's PARADE

Square D's PRECISION SNAP SWITCH

Use of this self-contained contact mechanism for limit switch applications provides more accurate operation, higher electrical ratings, longer mechanical life and minimum size.

1. Simple Operating Mechanism, consisting of only two alloy leaf springs, has no dead center position and gives exceptionally long life.

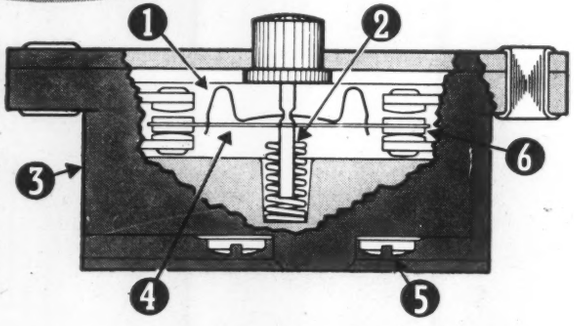
2. Compression Return Spring of stainless steel insures positive operation and long life.

3. Husky Melamine Case is not easily damaged through faulty installation or accidental impact, and is highly arc-resistant.

4. Heavy Contact Blade is entirely separate from operating mechanism.

5. Four Terminals have No. 6-32 binderhead screws suitable for No. 14 wire.

6. Separate NO and NC Circuits have double break, silver contacts. (See ratings below).



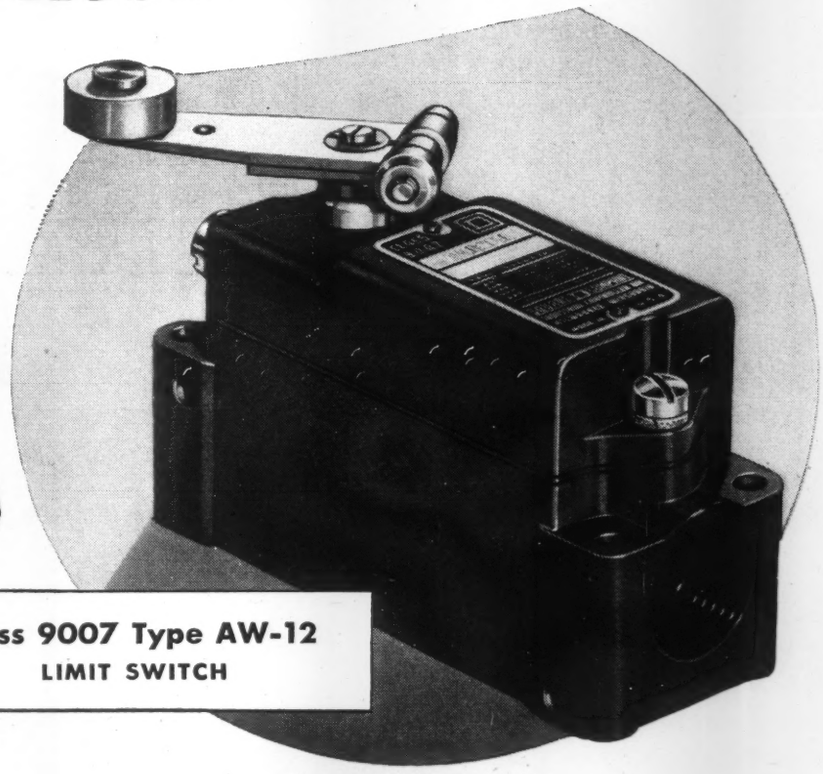
Electrical Ratings	A.C. Voltage				D.C. Voltage		
	110	220	440	550	115	230	550
Normal Amperes	15	10	6	5	2	0.5	0.1
Inrush Amperes	40	10	10	8	—	—	—

SQUARE D COMPANY

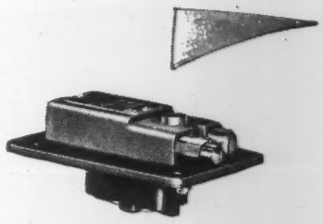
DETROIT • MILWAUKEE • LOS ANGELES

OF NEW DESIGNS

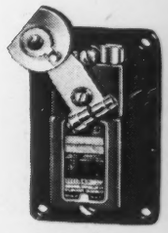
....*Now* available in oil-tight enclosures for machine tool use



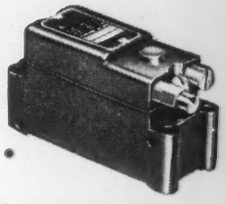
Class 9007 Type AW-12
LIMIT SWITCH



TYPE AF-22
Flush Mounting
Push-Rod-Operated



TYPE AF-12
Flush Mounting
Lever-Operated



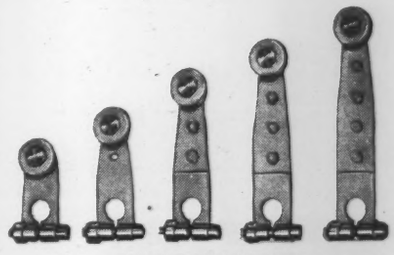
TYPE AW-22
Surface Mounting
Push-Rod-Operated

THE ENCLOSED PRECISION SNAP SWITCH has oil-tight die-cast enclosure with oil-proof cover gasket. Can be mounted in several positions . . . has ½" conduit entrance usable at either end of switch.

Operating arm adjustable to any position around circle . . . only 5° travel to operate with 25° over-travel in either direction . . . arms available in five lengths with standard, hardened steel roller ⅝" diameter and ¼" wide . . . one-way and other special rollers can be furnished.

Return springs easily reversed for either clockwise or counter-clockwise lever motion or removed for maintained contact action.

Surface and flush mounting arrangements with either roller arm or push rod operating mechanisms of various types, meet virtually any mounting and application requirement—without mechanical complications.



OPERATING ARMS
Available with ⅝" x ¼" Standard Roller or Special Rollers

Write **Square D Company, 4041 N. Richards St., Milwaukee, Wisconsin for complete details. Or ask your nearby Square D Field Engineer to show you a sample.**

If you need steel castings which will resist corrosion, the chances are 4 to 1 that your best bet is to have us cast them out of Circle Ⓛ 22 or Circle Ⓛ 23, Lebanon's two standard "18 and 8" stainless steels.

20 YEARS ago Lebanon began producing electric furnace castings of the "18 and 8" stainless alloys. Since then, they have proved their value under such a wide variety of service conditions that they have become known as the workhorses of the corrosion resistant alloys. Today they represent about 75% of the production of the Lebanon Steel Foundry's alloy output. This in spite of the fact that Lebanon has constantly pioneered the way in developing new alloys for special conditions.

Circle Ⓛ 22 and 23 are identical in analysis except for a lower carbon content in the former which makes heat treatment after welding unnecessary. The normal analyses and physical properties of these two alloys are summarized below. For more complete information write for our technical bulletin.

LEBANON STEEL FOUNDRY • LEBANON, PA.

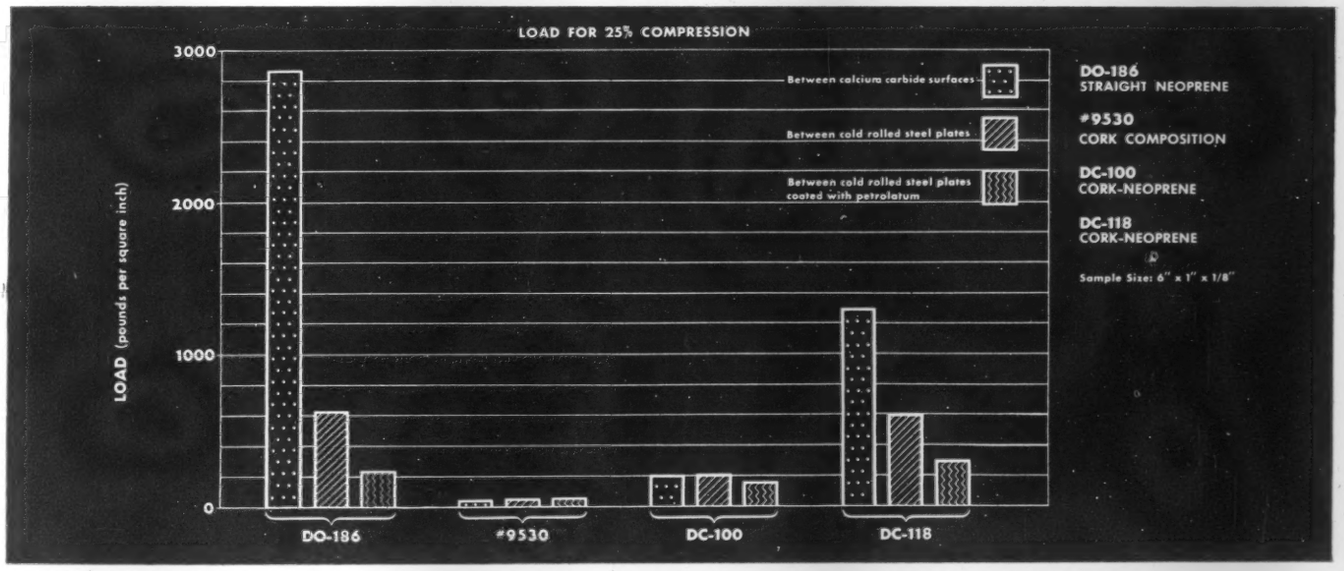
"In The Lebanon Valley"

ORIGINAL AMERICAN LICENSEE GEORGE FISCHER (SWISS CHAMOTTE) METHOD

LEBANON CIRCLE Ⓛ 22 AND 23

Lebanon Designation	NOMINAL ANALYSES							NOMINAL PHYSICAL PROPERTIES			
	C.	Si.	Mn.	Cr.	Ni.	Mo.	Special	Tensile Strength	Yield Point	Elongation in 2"—%	Brinell Hardness
Ⓛ 22	0.07 Max.	1.25	0.75	19.50	9.00			75,000	36,000	50	135
Ⓛ 22-M	0.07 Max.	1.25	0.75	19.50	9.00		Se. 0.25	80,000	40,000	45	160
Ⓛ 22-XM	0.07 Max.	1.25	0.75	19.50	10.00	2.25		82,000	42,000	50	170
Ⓛ 23	0.20 Max.	1.25	0.75	19.50	9.00			75,000	36,000	45	140

Lebanon CIRCLE L **ALLOY AND STEEL Castings**



EFFECT OF SURFACE CONDITION ON GASKETS

Greasy, oily, or smooth surfaces may upset load calculations

Common manufacturing processes often deposit grease or oil on surfaces that are to be sealed. Some processes leave surfaces smoothly finished. With such conditions certain type gaskets may skid and leak.

Non-compressible rubber materials slip badly on greasy or smooth surfaces. Thus grease, cutting oils, or a wet sticker can upset load calculations based on dry rubber placed between clean, non-skid plates. On the other hand, truly compressible materials are relatively unaffected by slick surface conditions.

The chart given above shows the comparative behavior of four different resilient materials when each is subjected to three differing surface conditions.

The first of these materials, Armstrong's DO-186, is a straight Neoprene compound. It requires a load of over 2800 pounds for 25% compression when gripped between silicon carbide surfaces. Between cold rolled steel plates coated with petrolatum, load for the same deflection drops below 250 pounds. Even without a lubricant, skid on smooth steel surfaces reduces the load required to about 600 pounds.

With cork composition, a truly compressible material, varying surface conditions have little effect. As shown in the chart, our #9530 Cork Composition compresses 25% with virtually the same load on a greasy surface as on dry silicon carbide. Maximum load variation is only about 3 pounds.

By combining cork and rubber in varying amounts, compositions can be made whose behavior on slick surfaces falls between that of cork and straight rubber. For example, Armstrong's DC-100 is a Neoprene composition with a high cork content. As shown in the chart, load on a greasy surface (160 pounds) is only slightly less than on silicon carbide (200 pounds). On plain rolled steel plates, no slippage at all is evident.

The fourth material charted, our DC-118, is more rubber-like in its behavior because it contains relatively little cork. Here load drops from about 1300 pounds on silicon carbide to 600 pounds for smooth steel plates. The same plates coated with petrolatum further reduce load to about 300 pounds. In each case, deflection is 25%. Other Armstrong's cork-and-rubber compositions provide intermediate degrees of compressibility.

★ ★ ★

Since many variables influence the choice of a gasket material, we recommend that you discuss your specific application with an Armstrong representative before you set up your specification. He will be glad to suggest suitable materials and supply you with various samples for testing.

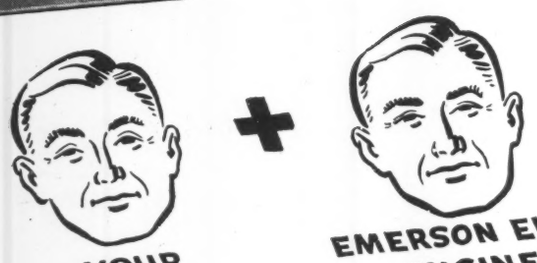
If you prefer, send drawings and details to us. You will find our recommendations unbiased and keyed to good current gasketing practice.

SEND FOR FREE BOOKLET. For specification and application data on Armstrong's more than 50 resilient sealing materials, send for a free copy of the latest edition of "Gaskets, Packings, and Seals," twelve pages of helpful information. Address Armstrong Cork Company, Gaskets and Packings Department, 5102 Arch Street, Lancaster, Pennsylvania.

ARMSTRONG'S
GASKETS · SEALS · PACKINGS

Cork Compositions • Cork-and-Synthetic-Rubber Compositions
Synthetic Rubber Compounds • Cork-and-Rubber Compositions
Fiber Sheet Packings • Rag Felt Papers • Natural Cork

Design Your New Product with "TWIN-GINEERING"



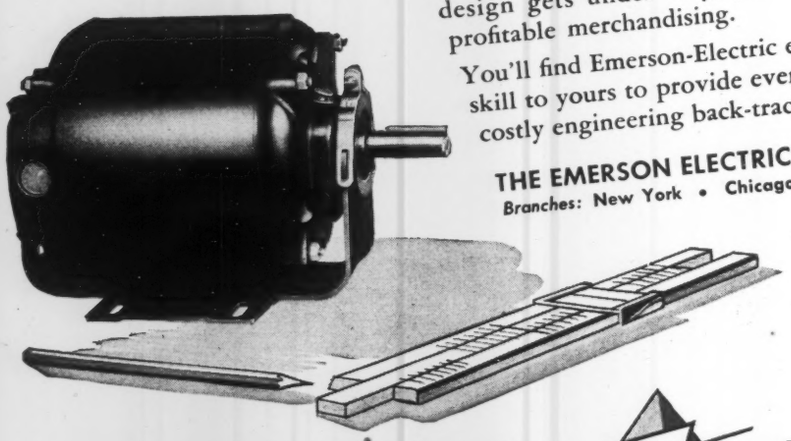
No getting around it, *two* engineering heads are better than *one.* And that goes double in designing motor-driven appliances to out-perform and out-sell the many new products soon to reach the market.

Today, of course, Emerson-Electric is booked solid on motor orders. But, this 57-year-old firm has never been "longer" on engineering brains, ideas, experience and skill. And never more willing to share these priceless advantages in suggesting and designing money-saving power applications for your future appliances or motor-driven equipment.

Now is the time to bring out those blue-prints and new product ideas which, through no fault of yours, have been deferred to *post* post-war planning. Let *your* engineering brains and *ours* collaborate in "Twin-gineering" so when the really tough competition of improved appliance design gets under way, you'll enjoy that advantage so necessary to profitable merchandising.

You'll find Emerson-Electric engineers eager to add their experience and skill to yours to provide every possible manufacturing short-cut and save costly engineering back-tracking.

THE EMERSON ELECTRIC MANUFACTURING CO., ST. LOUIS 21, MO.
Branches: New York • Chicago • Cincinnati • Detroit • Los Angeles • Davenport



EMERSON ELECTRIC
MOTORS · FANS — APPLIANCES

SHEARS • FORMS • PIERCES • CUTS OFF

and assembles

TELEPHONE PARTS onto BASE STRIP!

EXCEPTIONAL DIE ACCURACY plus high production required in producing these telephone parts necessitated die construction of the very highest calibre.

The Barth Die pictured above solved the problem practically and profitably.

A partially sheared and pierced strip is fed to this die which performs further important shearing, forming, piercing and cut-off operations of double parts, and in addition, assembles these parts onto a base strip which passes diagonally below the die.

Whatever your die, tooling or special machinery requirements, the specialized experience of Barth designers and engineers plus complete production facilities for handling complete or individual tooling programs is available to you.

DESIGNERS • MANUFACTURERS
DIES • TOOLS • GAUGES • JIGS
SPECIAL MACHINERY

BARTH

STAMPING & MACHINE WORKS, INC.

DENISON AT 34TH STREET • CLEVELAND 9, OHIO

Topics

UNITED STATES has become the first country to ratify the convention setting up the 25-nation International Organization for Standardization. The organization marks a new phase in international co-operation, according to Dr. Agnew, vice president of ASA, in that organized industry is taking an active and vigorous role in all of the countries toward freeing the flow of international trade.

MORE METAL POWDER was used in Germany during the war than in all other countries engaged in the war. In one month the Germans used more iron powder than we produced in a year. German equipment for producing hard cemented carbides has been brought to the Stevens Institute of Technology and should prove invaluable in powder metallurgy research. This equipment uses hot-press method rather than the cold-press method in general use here.

MOBILE POWER EQUIPMENT for farms, such as the tractor and its associated units, has probably been the greatest single factor during the past 30 years in making possible greatly increased food production with half the number of farmers. Within this period those engaged in farming have been reduced in number from one-third to one-sixth of our total population.

BEAM OF 70,000,000-volt x-rays has been produced in the General Electric research laboratory from a new and compact type of atom smasher called the synchrotron. In its present form the synchrotron combines certain features of the cyclotron with those of the betatron and is much smaller than either. At the University of California a 300,000,000-volt unit is under construction.

AIRBORNE RADAR — designated Eagle — for use at night and through heavy overcast was used against Japanese targets in the closing weeks of the war. Functioning with deadly accuracy, this revolutionary new equipment often rivaled results with optical bombsights against visual targets. Unique feature of the Eagle system is its 16-foot linear antenna structure, housed in an auxiliary vane beneath the B-29 fuselage and parallel to the wing of the aircraft. The structure has 250 minute individual antennas spaced along the vane.

GLASS-SILICONE LAMINATES, made from clean, staple-fiber glass fabric bonded with a silicone resin, have been developed by The Formica Insulation Co. for insulation applications in radar, television, motors, and similar equipment. Chemical grades of the laminates are extremely acid resistant, having been developed for wet-cell storage batteries.

NATURAL RUBBER, in returning to industrial rubber products after an absence of five years, is finding that many of the fields it formerly dominated are now pre-empted by synthetics.

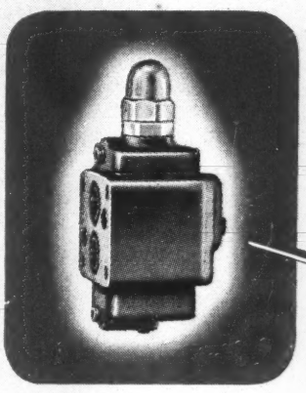
ARTIFICIAL PRODUCTION of snow by "seeding" a cloud with dry ice has been verified by Dr. Langmuir of General Electric Co. Where there are only a few isolated clouds in the sky, however, the method will tend to dissipate the clouds rather than precipitate snow.

SELF-HEALING CONDENSERS utilize a thin coating of metal deposited on paper. About one-third the size and weight of condensers employing metal foil and paper, these condensers deposit aluminum oxide on the paper at any incipient fault and thus restore the insulation properties of the paper dielectric.

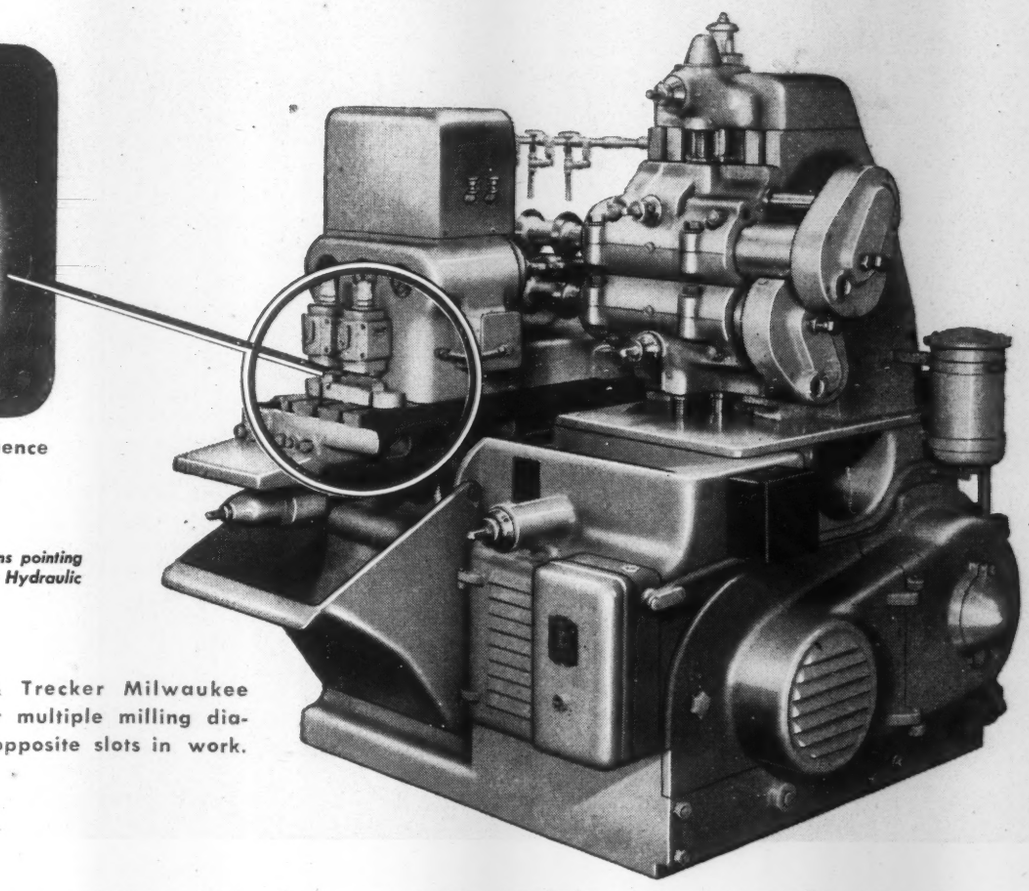
SPHERICAL ROLLER BEARINGS, 4 feet in diameter and 2½ tons in weight, are being manufactured by SKF Industries Inc. The largest bearings of their type ever built in the United States, they are being made for a super-calender now under construction at the Beloit Iron Works for Kimberly-Clark Corp.

VICKERS HYDRAULIC CONTROLS

Simplify Machine Operation... *Protect* Work and Machine



Vickers Hydraulic Sequence and Check Valve.



This is one of a series of applications pointing out the many advantages of Vickers Hydraulic Controls.

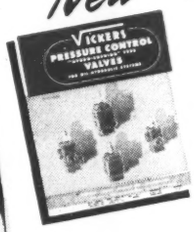
Kearney & Trecker Milwaukee Simplex for multiple milling diametrically opposite slots in work.

This is a representative installation of Vickers Hydraulic Controls featuring interlocking of machine operating phases by a combination of pilot interlocks and pressure sequence control valving. Three work arbors are indexed to position for simultaneous slot milling . . . accurate register and timing being assured by series connected pilot and pressure sequence interlocks. Thus all three pieces are in proper position before cutters approach the work. The same positive interlocking prevents succeeding automatic index until cutters are clear.

Other advantages of these valves: (1) they automatically provide "cushioned" operation, and (2) their ease of adjustment saves set up time when a variety of types of work is to be accommodated.

Our application engineers will be glad to discuss adaptations of Vickers Hydraulic Controls to your products.

New BULLETIN



Bulletin 45-34 on Vickers Pressure Control Valves includes operation, typical applications and installation of unloading, sequence, overload relief and counterbalance valves.

VICKERS Incorporated

1430 OAKMAN BLVD. • DETROIT 32, MICH.

Application Engineering Offices: ATLANTA • CHICAGO • CINCINNATI • CLEVELAND • DETROIT
LOS ANGELES • NEWARK • PHILADELPHIA • ROCHESTER • ROCKFORD • SEATTLE • TULSA • WORCESTER

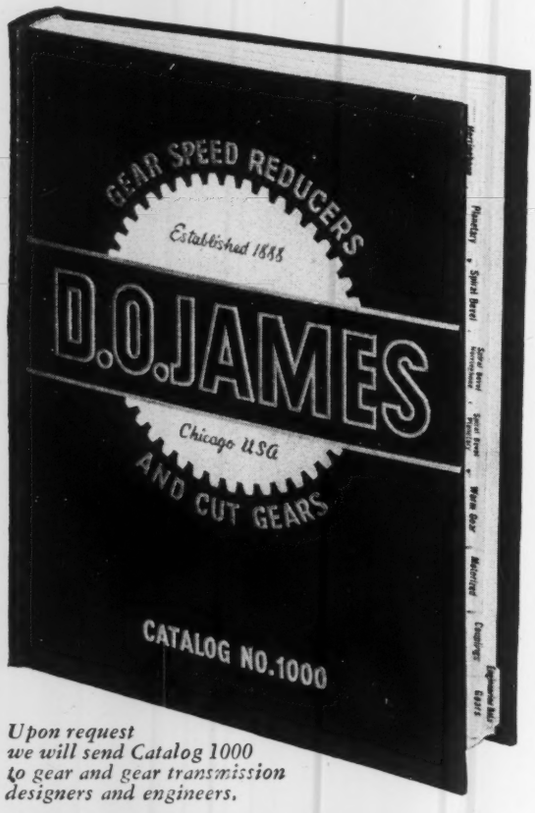
ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921

MAKERS OF EVERY TYPE OF GEAR AND GEAR SPEED REDUCER

D.O.James

Established 1888

CATALOG NO. 1000 — *It's new and complete . . . and contains the latest information available...*



Upon request we will send Catalog 1000 to gear and gear transmission designers and engineers.

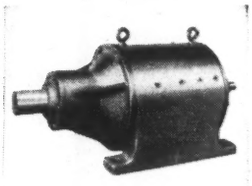
On the Engineering and Manufacture of Gears and Gear Reducers, Racks and Flexible Couplings

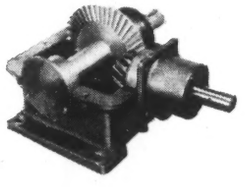
This 575 page indexed catalog contains essential practical information that will assist in solving gear and gear transmission problems. The contents of Catalog 1000 include extensive engineering data, rating tables, recommended practices for speed reducer selection, horsepower capacities of gears with examples, dimensions and list prices — also general information on design, construction and application of various types of cut gears, gear speed reducing transmissions and flexible couplings.

IMPORTANT ENGINEERING DATA

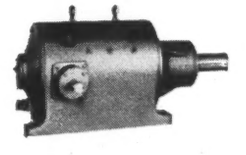
Catalog 1000 contains 100 pages of invaluable engineering data. This engineering section has been compiled and obtained from various accredited sources and includes tables, charts and formulas that have proven useful and helpful in gear design problems.

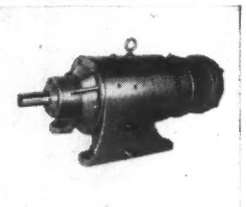
Continuous-Tooth Herringbone Speed Reducers


Planetary Gear Speed Reducers

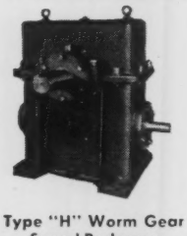

Spiral Bevel Gear Speed Reducers

Spiral Bevel Herringbone Speed Reducers

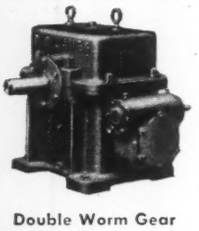

Spiral Bevel Planetary Gear Speed Reducers


Motorized Planetary Gear Speed Reducers

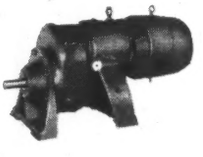
D.O.JAMES MANUFACTURING COMPANY
1140 WEST MONROE STREET • CHICAGO (7), ILLINOIS


Type "H" Worm Gear Speed Reducers

Helical Worm Gear Speed Reducers


Double Worm Gear Speed Reducers

Motorized Worm Gear Speed Reducers


Motorized Helical Gear Speed Reducers

MACHINE DESIGN

what's new in Plastics

A review of recent developments in materials, processes and applications

By John Delmonte
Technical Director
Plastics Industries Technical Institute, Los Angeles

DEVELOPMENTS in plastics materials, processes and their applications to industrial requirements are continuing at the rapid pace they had aquired at the end of the second world war. An analysis of recent developments reveals information which should prove of

Fig. 1 — Applications of polytetrafluoroethylene including flared tubing, threaded pipe, cylinders, spacers, gaskets, tape, valve-stem packing and a rod. Material is resistant to heat, solvents and corrosive agents, and has good insulation properties for electrical equipment

Noteworthy Mechanical Applications of Plastics

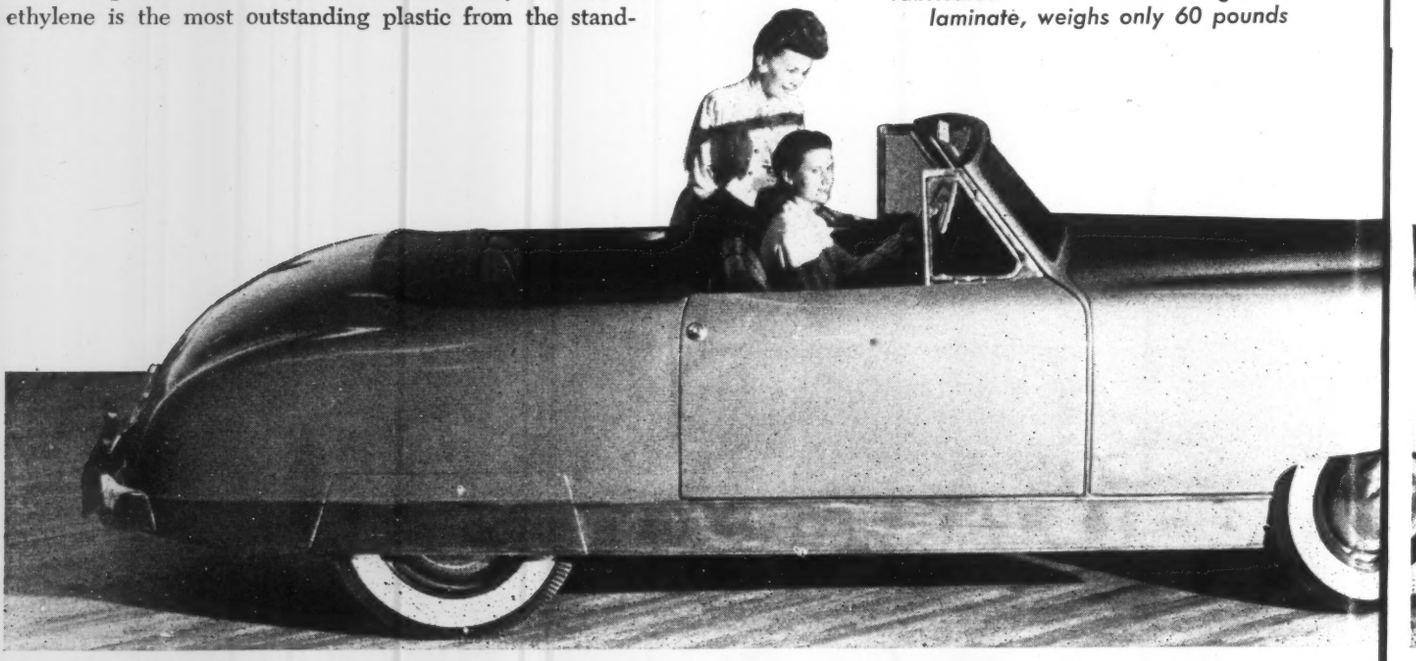
Material	Application	Design Advantages
Polytetrafluoroethylene	High temperatures and resistance to all chemicals	Flexible material suited for gasket, diaphragm, and insulation at high temperatures and under severe chemical exposure
Polyester bonded glass cloth with cellulose acetate core	Aircraft wing structure	True monocoque design now possible, eliminating ribs and stringers
Polyester glass cloth laminate	Automobile bodies	Complete integral construction, facilitating assembly of many small components in one operation
Neoprene or flexible elastomers	Check valves	Positive sealing, unhampered by dirt or grit
Cellulose acetate butyrate gel lacquers	Steering wheels and tool handles	Economical method of applying thick thermoplastic coating to complicated machine parts
Nylon	Valve seats in Navy torpedoes	No hand lapping, good seal at high pressures
Silicones greases and oils	Special bearing lubricants	Higher temperature operation and very low temperature operation —due to viscosity stability of silicone resins
Cellulose acetate butyrate and polystyrene pellets	Burnishing and removing carbon deposits from pistons	Tough, yet mildly abrasive action will not harm metal, but removes encrustations
Polyethylene	Thick wall sheath of cable insulation	Flexible elastomer with excellent dielectric properties
Phenolics	Permanent magnet particles cast integral with resin	German development which will influence design of magnets
Liquid polyester resins	Sealing porous metal castings	Improved performance and less rejections of porous metal castings
Polymethyl methacrylate	Roofs for cars, and 11 ft. diameter hemisphere	Maximum visibility, shock resistant
Foams	Sandwich constructions	High strength-weight ratio

value to the designer. Included in this analysis are pertinent data obtained from German practices, which were first made public during 1946. Also of significance to the machine designer, is the issuance of specifications by the Society of the Plastics Industry on the design of inserts and tolerances for molded parts. These specifications represent the integrated efforts of many technicians in the field who have combined their talents to issue design practices for different plastics materials.

Two new plastics materials made their debut in the United States recently. These are cellulose propionate (Forticel) and polytetrafluoroethylene (Teflon). The cellulosic plastic represents a valuable addition to the family of cellulose derivatives, offering good molding properties under variable production conditions and high impact qualities as a finished molded part. Compatible with cellulose acetate-butyrate in all proportions, it is adaptable to the requirements of injection molders. Polytetrafluoroethylene is the most outstanding plastic from the standpoint of chemical resistance. Capable of withstanding temperatures as high as 500 F and of resisting attack by all acids (including boiling aqua regia) and solvents, this new plastic will be used for important applications in temperature and chemical-resistant apparatus. It is claimed that no substance has been found capable of dissolving or swelling polytetrafluoroethylene. *Fig.* 1 illustrates various industrial applications including flared tubings, pipes, valve-stem packings, coaxial cable spacers, etc. For gaskets and high-temperature fittings this material is invaluable. Outstanding dielectric properties will also determine applications in high-frequency equipment.

Among those plastics which had been produced in Ger-

Fig. 2—Low-pressure laminated car body, fabricated in two sections of glass-cloth laminate, weighs only 60 pounds



many but are not manufactured in the United States at present are caprolactam, polyrethanes, and polyvinyl ethers. Caprolactam, a form of polyamide, is available as an elastomer which can readily be injection molded; polyurethanes have excited much attention because of their excellent adhesive characteristics; and polyvinyl ethers constitute important additions to the field of water-soluble resins as thickeners and sizing agents.

Developments in Structures

It is not easy to select the most outstanding recent applications of plastics to machine design, as there were so many new and significant developments during the past year. However, there are some which may be considered as opening up new design prospects, TABLE I. A group at Wright Field has produced a wing structure for aircraft, unemcumbered by ribs, reinforcing members, or beams and unmarred by rivet heads. A high-strength laminated Fiberglas skin, with a strong low-density core of expanded cellulose acetate, comprises the entire structure which tested far in excess of its rated design capacity. This assembly represents a close approach to true monocoque construction, which has been the goal of aircraft engineers for some time. Developments in earlier years on sandwich type construction, with a high-strength skin and low-density foam type or honeycombed core, have been employed for semistructural applications on aicraft.

Resin-bonded Fiberglas structures, however, have not been confined to aircraft. Complete car bodies have been glass-cloth laminated polyester resin binders, using simplified tooling. The illustration shown in *Fig.* 2 demonstrates a successful full scale model of the Darrin car produced in Los Angeles. The car body illustrated features a two-section laminated body weighing 60 pounds. A four-ply glass-cloth laminate is employed in its construction. The entire front section forward of doors including cowling, fenders, hood, head and parking light wells is formed at one time.

This assembly suggests the economies possible with the low-pressure laminating method of manufacture. Complete integral structures can be produced in one operation, without the assembly of many components at a later stage. In service the model in *Fig.* 2 demonstrated that its resiliency would enable it to stand up better than sheet-metal body types in minor collisions. Solid colors are, of course, entirely possible in the development of low-pressure laminates. From a production viewpoint, however, resin-bonded glass-cloth laminates have enjoyed their greatest success in the construction of small boats. One piece hulls, adequately reinforced, have shown excellent serviceability and complete waterproof qualities.

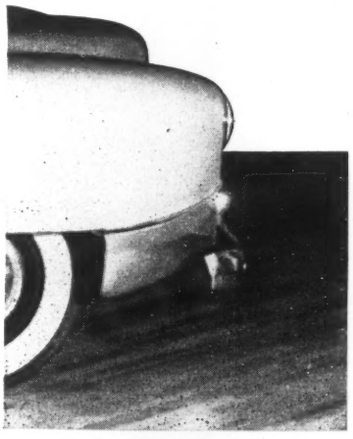
Competitive with the foregoing are developments with phenolic-resin impregnated sisal-fiber pads. During the past year, boat hulls and large one-piece caskets were molded from these materials in autoclaves. The assemblies were covered with neoprene blankets and shaped in fabricated metal molds under steam heat and pressure.

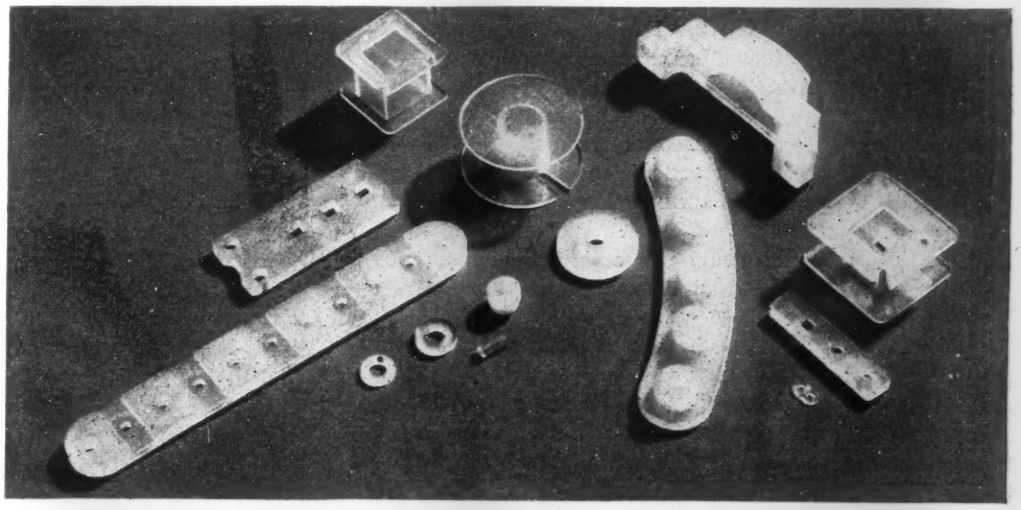
VALVES: Plastics and flexible elastomers have made important contributions to the manufacture of valve parts. One of these developments, a nylon base valve seat, was revealed during the past year by the Navy. Among the uses indicated were control mechanisms on compressed-air propelled torpedoes. The resiliency of the nylon insures a good seal and, unlike metal counterparts, nylon valve seats do not require hand-lapping for a good fit. Industrial uses of nylon are also appearing in many other applications. For instance, in *Fig.* 3 fourteen molded parts used in the Fairchild rate gyro are illustrated. Toughness of the material over a wide temperature range and in thin sections are cardinal advantages.

Proved Useful in Check Valves

Special check-valve designs, *Fig.* 4, demonstrate a novel approach to sealing the flow of fluids and gases in one direction. While the rubber-like body is molded neoprene, there is no reason why other elastomers such as plasticized polyvinyl chlorides or polyethylene could not be used. In operation, maximum opening is possible in one direction and, when the flow is reversed, the elastomer is collapsed, sealing the fluid. Elimination of springs and moving machine parts entails a mechanical simplification which is an important step forward in bringing out the good design

Fig. 3—Molded nylon parts used in Fairchild rate gyro include coil bobbins, terminal boards, insulating sleeves and a brush-holder assembly. Nylon is used because of its toughness over a wide temperature range, resistance to fungus and economical molding in small complex shapes





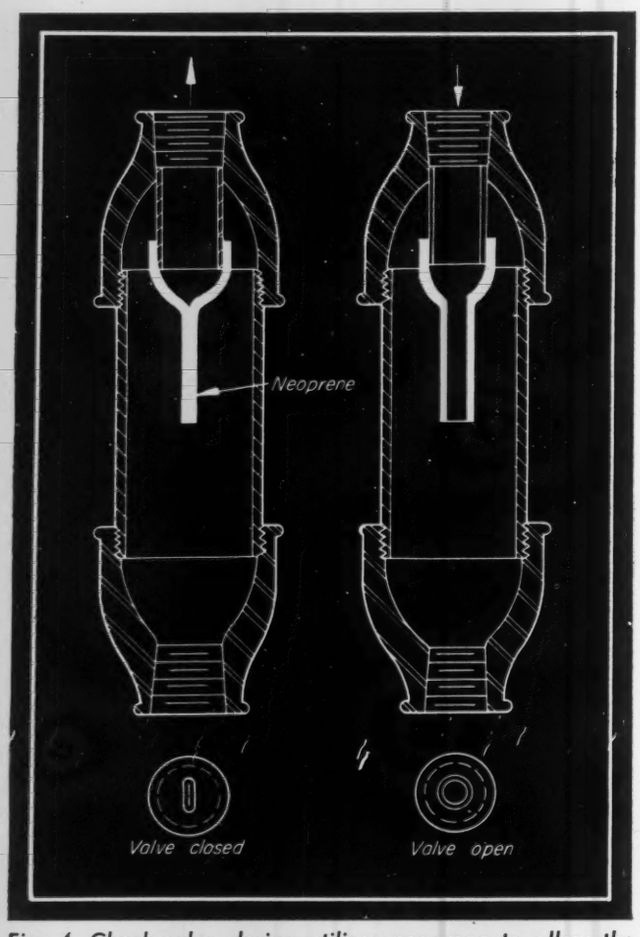


Fig. 4—Check-valve design utilizes neoprene to allow the flow of fluids and gases in one direction only, obviating springs and other moving parts

values inherent in plastic materials.

SILICONE GREASES AND OILS: Evaluation and practical application of silicone oils and greases to lubrication problems represent major contributions to machine design. Adaptation of these new resins to the lubrication of metal parts is not as simple as merely replacing petroleum-base oils, inasmuch as special studies must be conducted to determine the best conditions under which they may be applied. Silicone oils and greases have an important advantage inasmuch as they may be chemically compounded to fulfill specialized requirements. Interest in silicone oils stems from the fact that at subzero temperatures they do not stiffen but remain fluid. Likewise at temperature extremes they are less subject to deterioration than petroleum-base oils. However, silicones are many times more expensive and will be reserved for special-end uses only. Kaupi and Pedersen (MACHINE DESIGN, July, 1946) pointed out that one grease, DC-44, has about ten times the life of a good petroleum grease at high temperatures and high speeds. Additional advantages arise in the rust inhibiting qualities of these resins.

Silicone fluids, however, have a tendency to creep over surfaces and leak through mechanical joints. In tests of dimethyl silicone polymer fluids (*Transactions ASME*, May, 1946) it was observed that steel shafts seized when operating with cast-iron bushings but proved satisfactory with bronze bearings. In a hydraulic pump it was observed that steel upon steel would seize early and cause rapid wear. Further investigations revealed that pretreatment of bearings with silicone fluids before applying petroleum lubricants improved the load carrying ability. Among the fluids, DC 710 (Dow-Corning) series resulted in the least wear on bearing surfaces.

Among other design expedients recommended for silicone fluids is the use of flinger rings to prevent leakage. Specially formulated synthetic-rubber seals were necessary because the usual formulation showed evidence of attack by silicone resins.

Silicone resins formed upon the surfaces of porous substances such as ceramics and cellulosic products, establish an excellent moisture repellant layer, preventing the formation of water films. Solid, heat curing grades of silicones are already well known from earlier years in their outstanding applications as high-temperature resisting electrical insulation. For instance, capacity of electric motors is generally limited by the temperature resistance of the insulation and, with the advent of these new resins and materials such as polytetrafluoroethylene, it should be possible to increase horepower output appreciably. Glass cloth generally serves as the reinforcing laminae in these

Wichita City Library

applications to electrical equipment.

CELLULOSIC PLASTIC COATINGS: The gel-lacquer technique was developed for the application of heavy protective coatings on machine parts. These coatings undergo gelation without the necessity of solvent evaporation. This technique provides an economical method of applying thick coatings by dipping. Cellulose acetate butyrate (Tenite II) formulations have been applied in this manner. Dipping takes place at 120 F and the coating hardens when cooled to room temperature. *Fig.* 6 illustrates a lightweight airplane control wheel of cast aluminum which has been dipped in a gel lacquer. The attractive dark red finish is smooth, pleasant to handle, tough and chip-proof.

Useful in Blasts for Cleaning

Another striking application of cellulose acetate butyrate, though in an entirely different field, is the use of the material in the form of fine particles (10-32 mesh) as a soft grit cleaning compound. Impinged against carbon deposits on cylinders and pistons of aircraft engines, they have not damaged the metal underneath. Thermoplastics other than cellulose acetate butyrate can also be used for the same purpose.

A third development of cellulosic plastics worthy of note is their use on the keys of the adding machine illustrated in *Fig.* 5. First, cellulose acetate butyrate of one color is injected into the molding cavity to form the lettering. Then, upon setting a second contrasting color follows for the body of the key. Permanent markings thus are insured and the solid integral colors eliminate filled embossing, hand painting or applying decalcomanias. The technique of double-injection molding may be employed in another manner: A core of relatively inexpensive composition may be molded, followed by an outer casing of more costly and more attractive material. Additional tool and die costs, however, are necessitated.

TRANSPARENT ACRYLIC ENCLOSURES: There are two outstanding applications of transparent acrylic enclosures which should attract the interest of designers. One is the development of transparent acrylic roofs (Plexitop) for automobiles. The front windshield, which must resist abrasive dust, is glass but the roof is acrylic sheet stock.

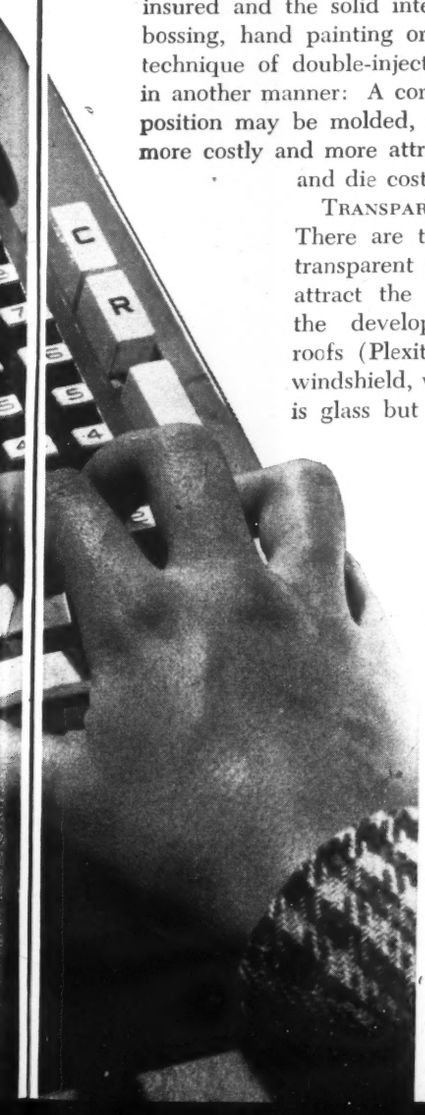


Fig. 5 — Double-injection molded keys on adding machine have permanent numerals. One color is injected to form letters followed by second color for body of key

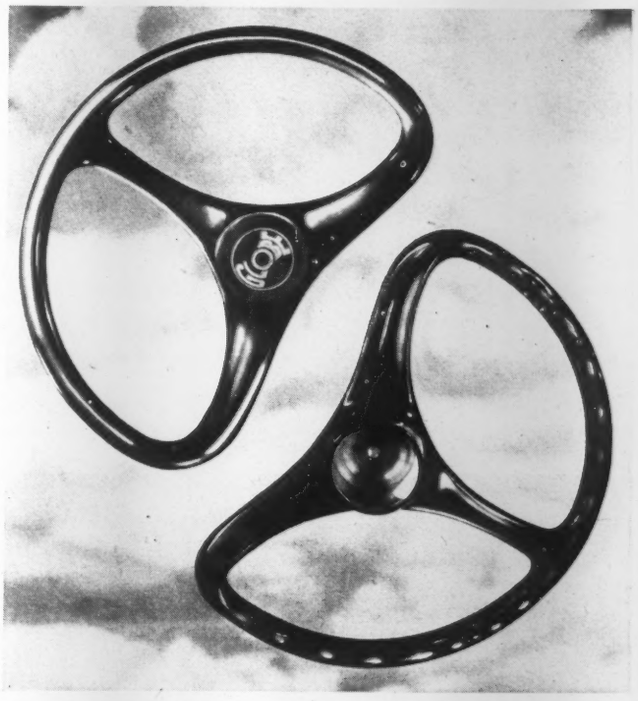


Fig. 6—Gel-lacquer technique provides attractive plastic coating on cast aluminum, making a lightweight control wheel for aircraft

The second development in acrylic enclosures necessitated special manufacturing techniques, particularly because only one unit was manufactured. This was the largest acrylic hemisphere ever manufactured, formed for the Ford Motor Co. for an advertising display. The hemisphere measures 11 feet in diameter and weighs 300 pounds. Before forming, it was necessary to weld together four standard size sheets. The single intergrated sheet resulting was then drawn to size by vacuum.

POLYETHYLENE IN INSULATION: One of the most noteworthy uses of polyethylene during the preceding year was an application to the outside of electric cable. Polyethylene serves as the thick, extruded insulation, offering mechanical as well as chemical advantages. Inasmuch as polyethylene is relatively inert to chemical attack and will not affect bare copper wires, the tinning operation usually necessary to protect the copper from the suphur in the rubber composition should not be required.

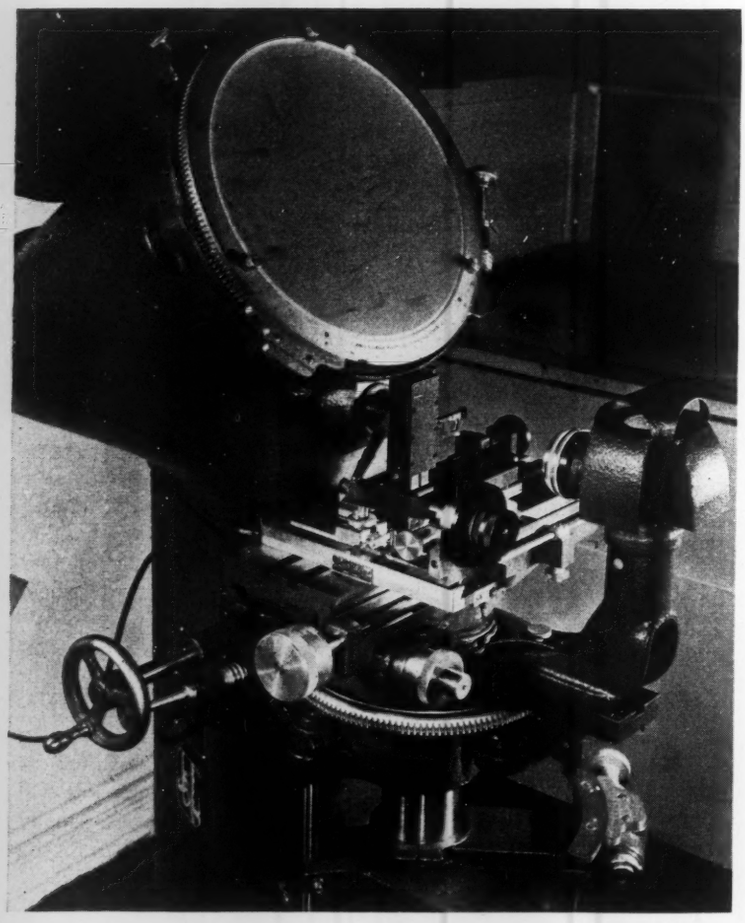
Reclaims Faulty Castings

SEALING POROUS CASTINGS: Interest appears to be growing in the technique of sealing porous castings with the aid of liquid resins. The advantages are many, principally when it is considered that many costly castings may be salvaged by the impregnation technique. In most instances the porosity of a casting may not be observed until after machining operations have exposed unsuspected flaws.

Generally the technique of impregnation consists of coating the well or cavity in the casting with liquid resin and then applying either an internal pressure, or a vacuum from the opposite side. The net result is introduction of the plastic which is then cured in situ. Low viscosity

(*Continued on Page* 182)

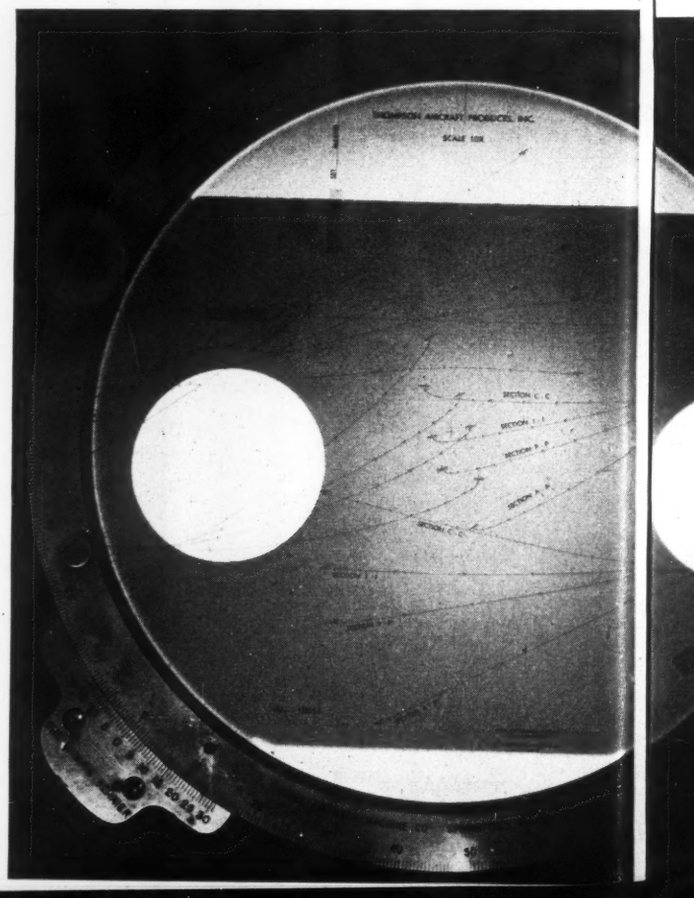
Scanning THE FIELD for Ideas



CONTOURS of precision parts with varying sections may be checked accurately with an optical comparator equipped with a tracer device illustrated in the photograph at left. Known as the Pant-O-Jector, developed by Engineers Specialties Division of the Universal Engraving & Colorplate Co., this tracer employs a roller for traversing any desired section of the object to be measured.

Constant contact pressure, which is both light and uniform, is maintained on the tracer through employment of a counterbalance of proper weight, located within the box-like shaft to which the tracer is attached. Also attached to this vertical shaft and located in the optical field is a hole corresponding in size exactly with the diameter of the tracer roller. Through this hole is projected a spot of light onto the viewing screen. As the tracer is fed across the section to be gaged, the spot follows on the screen but with travel multiplied ten to one hundred times, depending on the magnification being employed. If the travel of the tracer exceeds the limits of the screen for the magnification desired, a second hole or "eye" is utilized. These eyes are so spaced that the second appears on the screen before the first passes off as shown in the screen below.

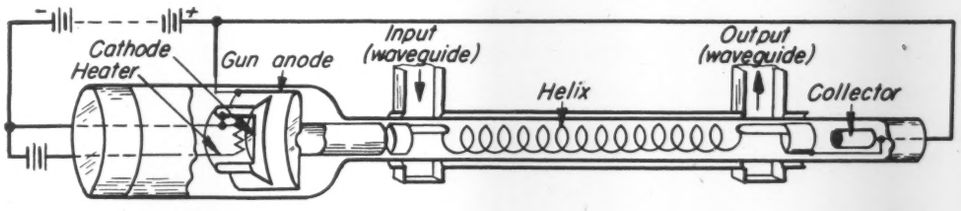
In the screen illustrated, four section contours are employed, including top and bottom profiles for each of two eyes. Profiles for the first eye start in the central portion of the screen and those for the second eye as it appears at the left margin. Orientation of the screen is obtained by registering the eye

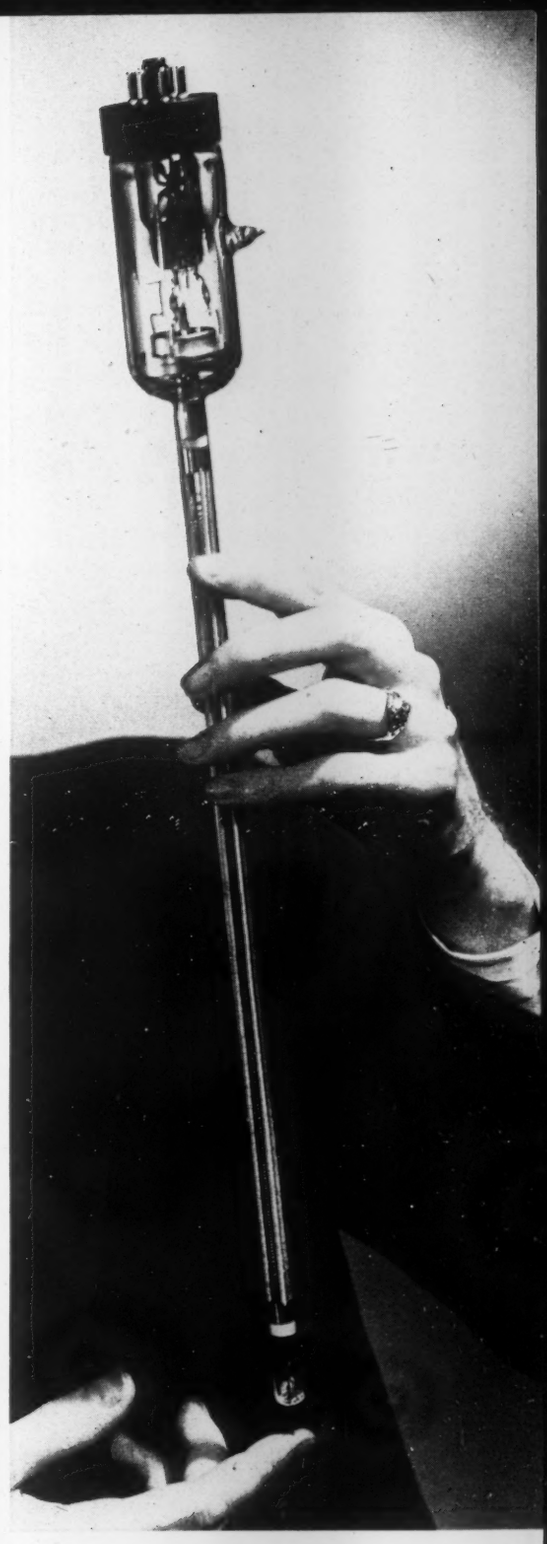


tangent to the co-ordinates at the upper left of the screen while the tracer rests on a reference block on the workpiece fixture. To produce a gage chart, cross-hairs are employed in the eye and each reference point marked on the chart. With circles of the projected eye diameter drawn at each point, the curve tangent to the circles becomes the chart profile.

Traveling-wave vacuum tube illustrated at right promises to overcome amplification limitations of present types of tubes used for microwave frequencies in television and other communication equipment. For instance, present-day tubes such as disk-seal triodes and klystrons have an amplification of 10 decibels with a band width of 10 megacycles, 4 db for 20 megacycles and 0 db gain (no amplification) at 32 megacycles. The recent development of the traveling-wave tube by Bell Telephone Laboratories has an unprecedentedly high gain with a band width about 80 times greater than has been practicable with other tubes.

Differing widely from other tubes in appearance, construction and operation, the tube has, in common with other tubes, an evacuated envelope and a stream of electrons. Accelerated from a hot cathode, the electrons shoot down the axis of the tube in a narrow beam and are focused and guided by magnetic fields. No grids are employed and the electrons striking the anode do not carry the amplified output, since the amplifying has been completed before the electrons reach the anode.





Surrounding the electron beam is a helix wire carrying the signal current which produces electric and magnetic fields. Interaction of the electrons with this field produces the amplification; the greater the electron current or the longer the helix, the greater is the gain. No tuned circuit is used.

Cross section of the tube is shown above. Two wave-guides are fitted near the ends of the helix. Also, at each end of the helix are fastened a collar and a short straight section, the latter acting as antennas to couple the helix to the guides. In the tube the electrons move faster than the increasing wave, forming an "electron wind" giving energy to the wave as it moves along.

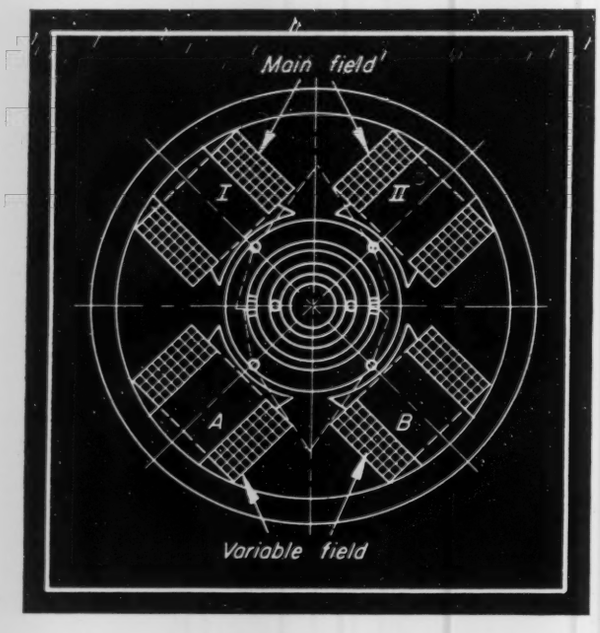
Eight-to-one speed range for direct-current motors, using two-circuit winding on the armature and two sets of field windings has been proposed by Westinghouse. Such a system would mean greater flexibility because the speed range is practically stepless.

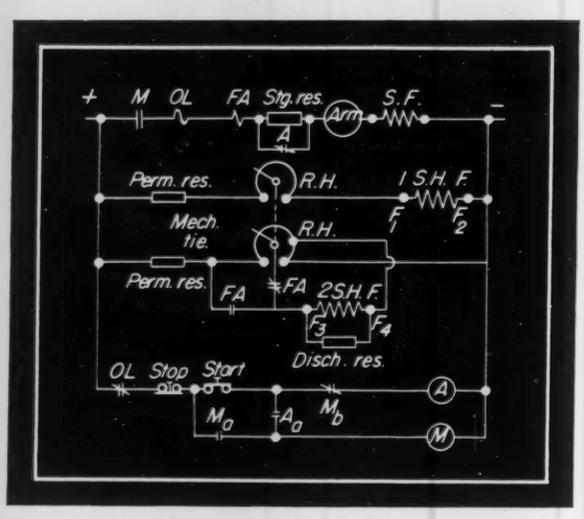
With the two-circuit armature winding there are only two circuits between brushes of opposite polarity and the voltages generated in the coil sides under each of the four poles add algebraically between the brushes of opposite polarity. Arrangement of the field coils

and the control diagram are shown below. On the poles, two windings form the main field and two others a variable field. This makes it possible to keep the first two poles at full field cumulative while the second set is varied from full field cumulative to the required differential value.

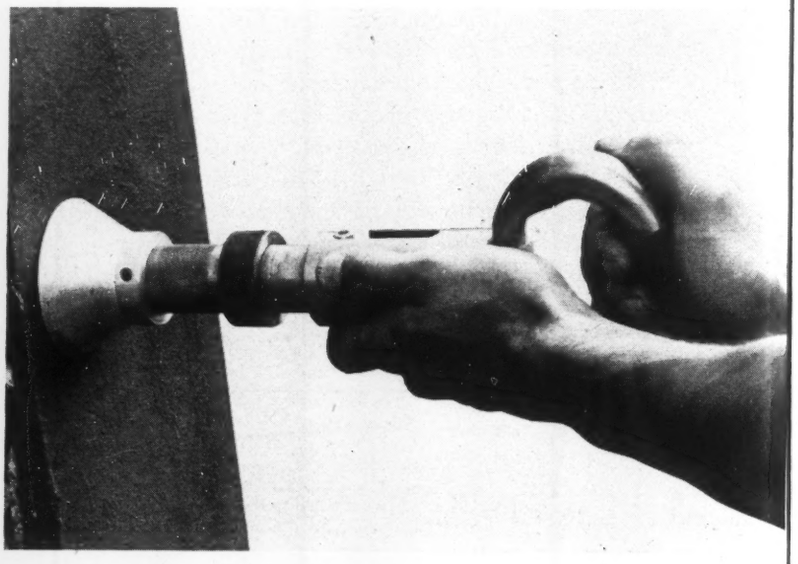
This design also meets the condition of stiff fields except at twice speed. By making a special pole tip design, satisfactory commutation can be obtained at eight times base speed. Higher efficiencies and better regulation can also be obtained if the main field is varied down to 60 per cent full field. Flux necessary to obtain eight times base speed is but 12½ per cent of normal.

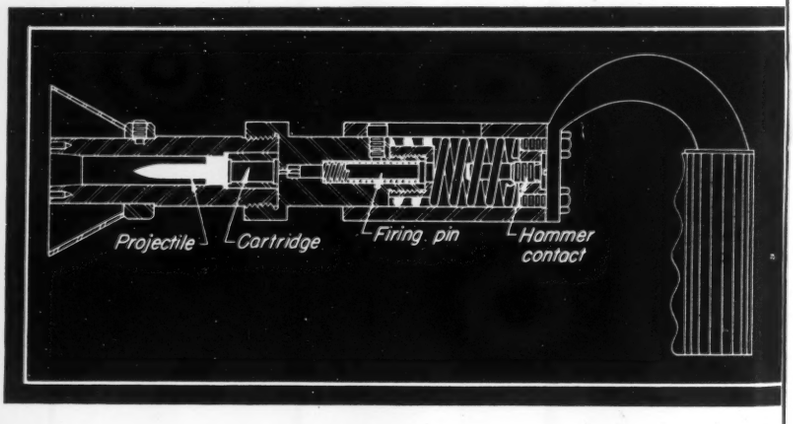
In the control diagram, coils F1F2 are located on the main field and coils F3F4 on the variable field. The rheostat in series with the former coils has its shaft connected mechanically to the potentiometer for the latter, giving one rheostat knob for speed adjustment over the range. The rest of the circuit shows the starting means and the field accelerating relay.

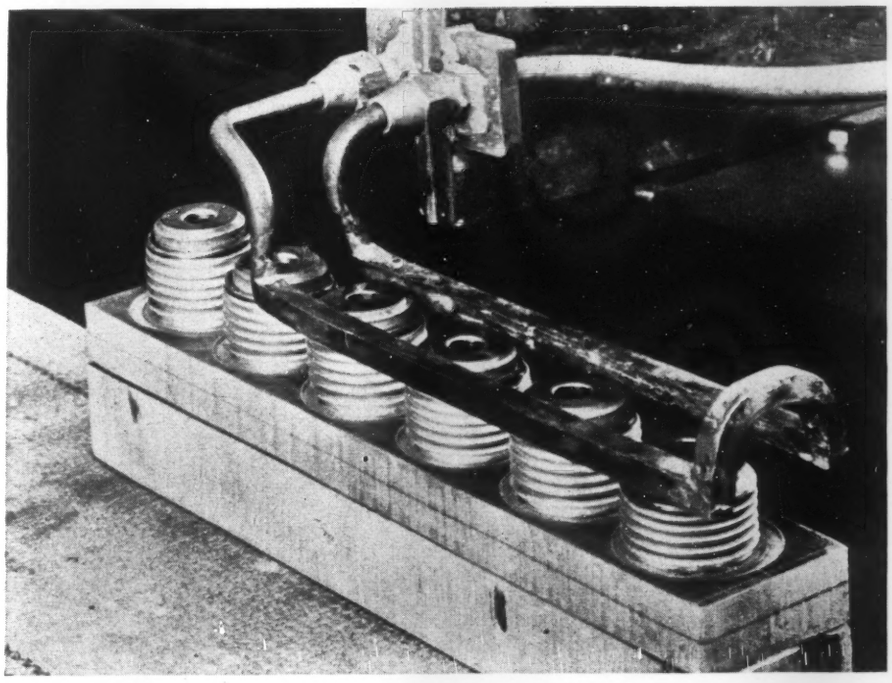




Powder actuated, the hand tool below develops a momentary force capable of driving a threaded stud into steel up to 1¼-inch thickness. Utilizing only a blank cartridge for driving force the gun, designed by Tempotool Co., is shown in cross section below. Projectile employed has a thin flange, flush with the head, to provide a seat in the barrel liner and to confine the explosive gases until sufficient pressure is developed to shear off this flange. This restricting action results in the projectile being driven forward with a velocity far greater than that of an ordinary bullet. The relative weakness of the projectile flange, however, contrasted with the strong stainless and heat-treated alloy steel barrel and breach chamber provides a safety release against damage to the tool.





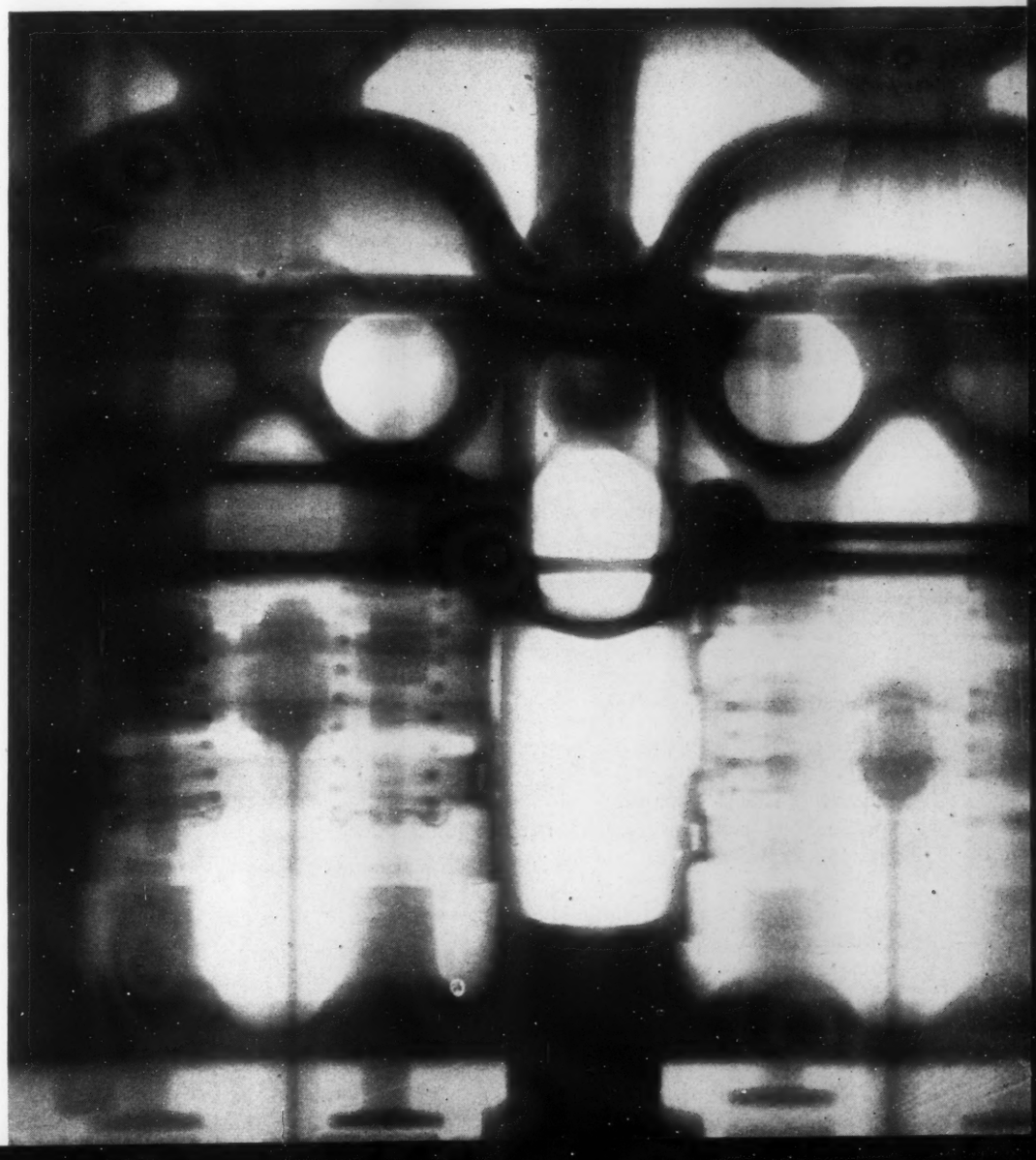


Induction heating lends itself readily to "production line" method of manufacture as shown in the photograph above. This application, designed by Westinghouse Electric Corp., is a brazing operation in which the parts are carried through the inductor coil on a conveyor. The coil is so shaped that the parts to be brazed may pass through the coil without interference, obviating raising the parts into the coil as they pass. Control of time and temperature is automatic.

Radiographs made with twenty-million volt x-rays have many advantages not found in those produced from lower voltage rays, according to J. P. Girard of Allis Chalmers Mfg. Co. Maximum penetration without loss of detail are obtainable in heavy sections of steel, brass, bronze, and copper. With lower-voltage x-rays the minimum flaw which can be detected varies with the thickness of section and the position of the flaw in the specimen. Using twenty-million volt radiographs, the minimum detectable flaw is the same for any thickness of specimen or the position of the flaw in the specimen. For instance, a flaw of 1/32-inch is detectable in steel in thickness from 2 to 12 inches using Eastman type A film.

Below is shown a radiograph made in 18 seconds with a twenty-million volt betatron showing a bent valve in an L-type engine. The film was 5 feet from the betatron target. Visible are clearances from stud ends to bottoms of tapped holes, around studs at manifold connections, and between cylinder and piston as well as rings.

CORRECTION: The spring clutch discussed last month on Page 91 was developed by Willard E. Swift Jr., Foxboro, Mass., not Williard E. Smith as stated.



Escapement Mechanism

By F. G. Kelly and J. L. Zar

Edison Laboratory
Thomas A. Edison Inc.
West Orange, N. J.

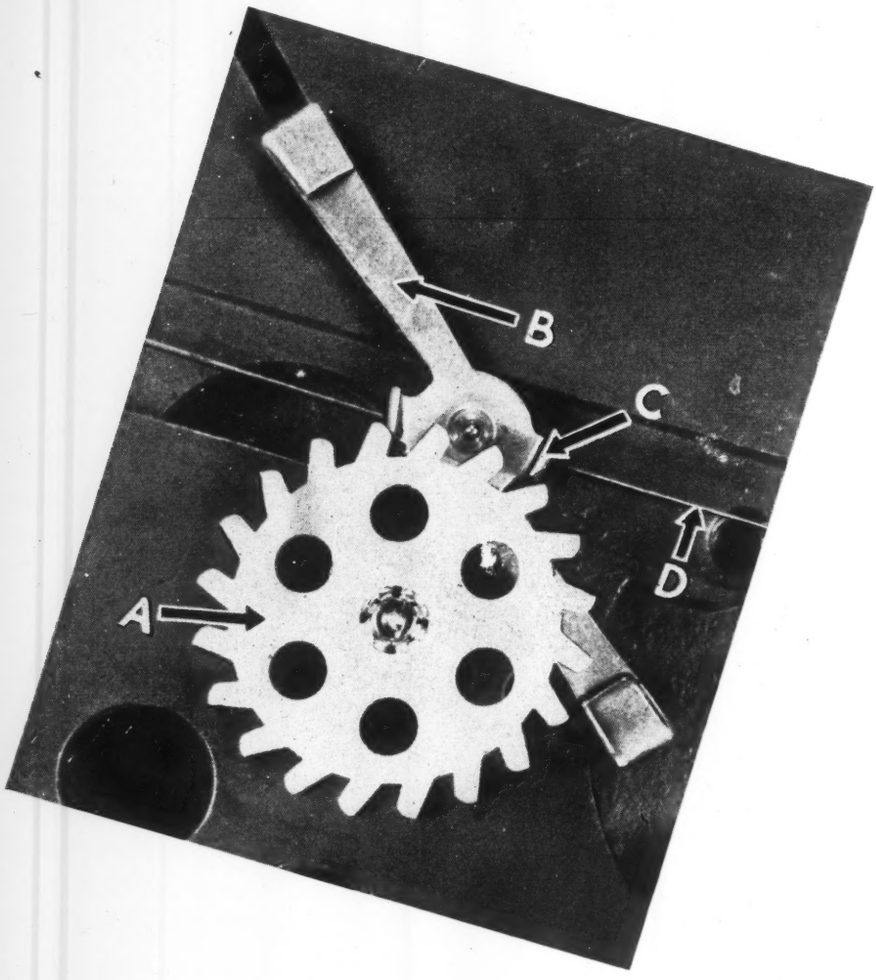


Fig. 1—New escapement in operating engagement. A is escape wheel, B is escape lever, C is escape-lever pallet, and D is escapement spring. About 4 times full size

REDESIGN of a conventional wheel and oscillating-lever type of mechanical time-fuze escapement, discussed in this article, was undertaken for two reasons: To produce a better timekeeper and to reduce the cost and time of manufacture. The rate of the original (Mark 18) escapement is relatively sensitive to driving torque which diminishes as the fuze runs out, hence there is a timing error which increases rapidly with the time of flight. Since this characteristic is not the same for each fuze, there results a scattering of the firing time which may amount to ±0.10-sec after 45 sec of flight. The new escapement, *Fig.* 1, was designed with a view toward minimizing this torque sensitivity.

The original fuze design also required very exact escapement dimensions. In its manufacture, hand-matching of escape levers and wheels was required because, with the closest tolerances that could be maintained in production, the parts could not be made accurately enough. Ten sizes of wheels were necessary, diameter varying in steps of 0.001-inch. Selection of the proper size of wheel for each individual fuze was left to the judgment of a skilled operator. Where a poorly matched escapement was selected, the error was not detected until the fuze was completely assembled and tested, resulting in a small percentage of rejects due to faulty escapements which had to be reworked. The second object of this development included obtaining an escapement in which a single size of wheel would serve for all fuzes.

How the performance of shell fuzes was improved by redesign of the escapement mechanism is explained in this article, which is based on a paper presented at the recent annual meeting of A.S.M.E.

Development work was limited to revisions of the standard fuze escapement, because it was necessary to incorporate the results into large quantity fuze production with a minimum of changes. In a fuze, the escape lever and hairspring approximate a simple harmonic oscillator maintained in continuous oscillation by impulses supplied through contact of the escape wheel with the pallets. It is well known that if the frequency of a mechanical oscillating system is to be made independent of variations in driving force, the driving impulses should arrive, on the average, when the mass is passing through its neutral position. This is the position of greatest velocity when the lever is moving. It is also the rest position when the lever is stationary. If this condition is met the frequency of oscillation is independent of the driving force and the escapement is a good timekeeper.

A limited analysis of the Mark 18 escapement for causes contributing to its torque sensitivity will be discussed first. In *Fig.* 2 the escape pallets are shown in their neutral positions, the escape-wheel teeth being shown in a posi-

tion where the trajectory of the tips of the pallets can touch the base circle. (The phrase "base circle" is used here in the same sense as in gear-tooth design.) Left and right sides are both shown in this same phase of escapement for convenience, but are actually one half-cycle apart in time.

In this escapement there are several impulses of momentum delivered to the lever during each oscillation cycle. What may be thought of as the normal driving impulse is the force of the escape-wheel tooth against the pallet as the curved portion of the tooth moves under it. Torque on the lever results from the slope of the tooth contour. Referring to *Fig.* 2, it will be seen that the curved or working portion of the tooth occurs almost entirely above the neutral circle. This means that the working impulses do not occur at the neutral circle but above it. Therefore, if these were the only impulses acting, the escapement would be highly torque sensitive. As will be seen there are other types of impulses present and the overall torque sensitivity of the escapement depends upon the general effect of all.

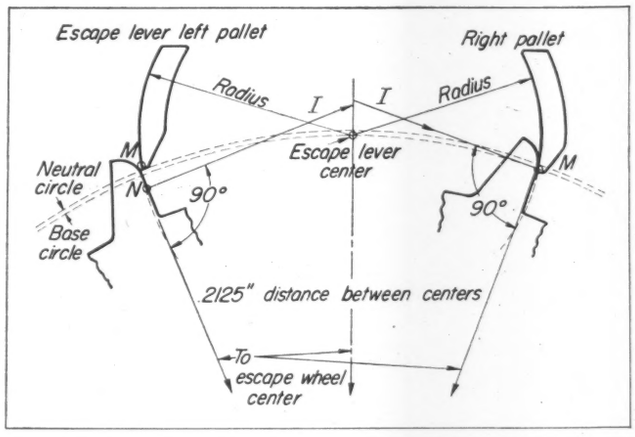
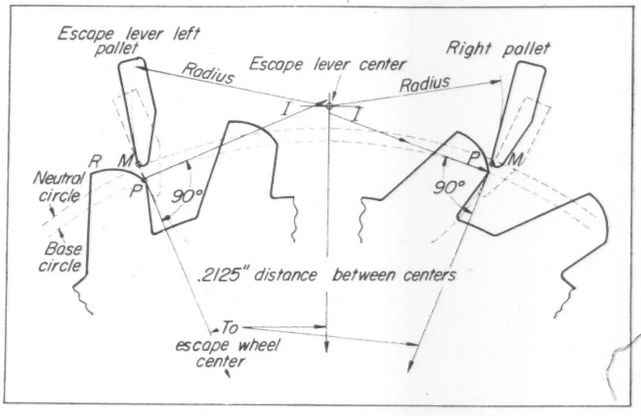


Fig. 2—Above—Mark 18 escapement action. The fall impulses, I, act above the escape-lever center

Fig. 3—Below—Action of new escapement which is designed so that the fall impulses, I, come on the average at the escape-lever center



Another, large, impulse of momentum results from the fall impact of a tooth against a pallet. This follows the escape of another tooth from the opposite pallet. Unless the line of action of this fall impact passes through the center of rotation of the escape lever, it will affect the oscillation frequency. An analysis was made to determine the direction of action of the fall-impact force. This involved factors such as the coefficient of friction, the direction of motion of the lever, and the relative velocity of the teeth and pallets. Some of these factors are uncertain and the conclusions are only approximate, but it appeared that the most probable direction of the impact force is the vector *I* in *Fig.* 2. This is in the direction of motion of the escape-wheel tooth, at right angles to the radius of the wheel at the point of impact.

Variable Moment Due to Fall Impact

Fall impact on the left pallet occurs at a variable point, *N*, anywhere along the straight portion of the tooth depending upon the operating torque on the wheel. At the right pallet the fall occurs always at the same point, *M*, on the base circle, because the tooth is sufficiently undercut for the righthand angular position. Fall impacts contain a great deal of momentum due to the large angular distance through which the escape wheel has accelerated before being stopped. They occur at a time when the escape lever is about farthest from its neutral position, and in the Mark 18 fuse exert a large and variable clockwise moment about the escape-lever center, hence they are a major factor contributing to the torque sensitivity of the escapement. (This explains the tendency of the Mark 18 escapement to lock on its right pallet under excess operating torque. The strong counterclockwise fall impulses throw the lever into deep engagement on its right side where a small amount of friction stops the motion completely.)

To summarize: (1) Normal driving impulses, which are clockwise for the left pallet and counterclockwise for the right, occur outside the neutral circle; (2) Fall impulses partly cancel each other because the one on the left side drives the lever while the right one retards it. They occur within the neutral circle. The left impulse originates from a variable point on the tooth, but the right one originates from a fixed point; (3) Absence of a true "dead-beat" action on the left pallet due to the forward slope of the straight portion of the tooth contributes two additional clockwise impulses to the left pallet. There is no counterpart for the right pallet.

Reason for Torque Sensitivity

Torque sensitivity of this escapement is attributable to the fact that the net resultant of these several impulses varies in amount and direction with the driving torque, and does not in general average about the neutral position of the lever.

In the Mark 22 (U. S. Army) escapement, the normal driving impulses very nearly straddle the points of maximum velocity of the pallets. However, as in the Mark 18, there are the same off-neutral fall impulses, *I*. This escapement is an improvement over the Mark 18 in that both the fall impulses occur on the base circle, and there are no impulses due to imperfect dead-beat action. For this reason it is probably a less erratic escapement. However, it also is relatively torque sensitive.

After the foregoing analysis to determine the possibility

for improvement in existing escapements, a new design was undertaken. An analysis of the new escapement is shown in *Fig.* 3 and the component parts are illustrated in detail in *Figs.* 4 and 5. The new escapement was designed according to the following principles:

1. Location of the wheel and lever centers in the fuze plates, and the center distance, were not changed, so that the remainder of the fuze would be unaffected by changes in the escapement.

2. Leading edge of the escape tooth was undercut sufficiently to cause the fall impact to occur at point *P* on the base circle under all conditions.

3. The base circle of the wheel was located with respect to the centers of the wheel and lever so that the line of action of the fall impact *I*, taken in the direction of motion of the tooth, passes through the center of rotation of the lever. This prevents the fall impacts from producing driving torques and disturbing the frequency of oscillation.

4. An escape-tooth form was derived, as outlined later. It delivers an efficient impulse over the major part of the curved portion of the tooth. The tooth form was made as broad as possible, consistent with the amount of space available, so as to obtain a maximum depth of engagement for reasons of safety.

5. The tips of the pallets were so located that the normal accelerating impulses occur symmetrically about each side of the neutral circle. That is, the neutral circle was made to intersect the curved portion of the tooth at the mid-point of the angle subtended by the radii *OP* and *OR* from the center of the lever to the ends of the curved portion of the tooth.

6. In designing the escape wheel, it was desirable to have as many teeth as possible and still allow free pallet action with adequate tolerances. These considerations permitted up to 24 teeth, but the number chosen was 20 to allow an easy changeover in the dynamic test equipment used with the former 30-tooth escapement.

Oscillation Frequency of Escapement Reduced

7. In order for the new fuze with two-thirds as many teeth to run as long as the Mark 18 (45 sec), it was necessary to reduce the oscillation frequency of the escapement proportionately. This was done by adding weights to the ends of the lever, keeping the same hairspring.

8. Manufacture of the new lever was simplified by making the pallets straight-sided instead of cylindrical and by swaging rather than grinding the angle of their back surfaces. (These are the surfaces which operate against the angles of the backs of the escapement teeth during reverse running of the fuze when it is being wound.)

9. In adapting the new escapement to the Mark 18, a small amount of routing was necessitated in the No. 2 plate to clear the weights added to the lever.

Tooth form was designed to transfer energy from the wheel to the lever efficiently and to produce the driving impulses, on the average, when the lever was passing through its neutral position. To transfer energy efficiently, the time of contact of the pallet with the tooth during the escape phase was made as long as possible by providing a broad tooth. To place the impulses properly it was not sufficient to use the geometrical layout as explained in item 5 previously. It was also desired to have a tooth form which would apply approximately a constant force to the escape lever during the entire time that the pallet and tooth are in contact.

The form for the escape surface is derived by assuming a wheel accelerating from rest under a uniform torque, a pallet traveling with uniform angular velocity, and by tracing the curve described by the pallet contact point *M* on the wheel. Assumption of a uniform angular velocity for the pallet is not strictly correct, but the approximation has not led to serious error.

In order to simplify the discussion, losses in the oscillating lever will first be neglected. Following this treatment the derived tooth form will

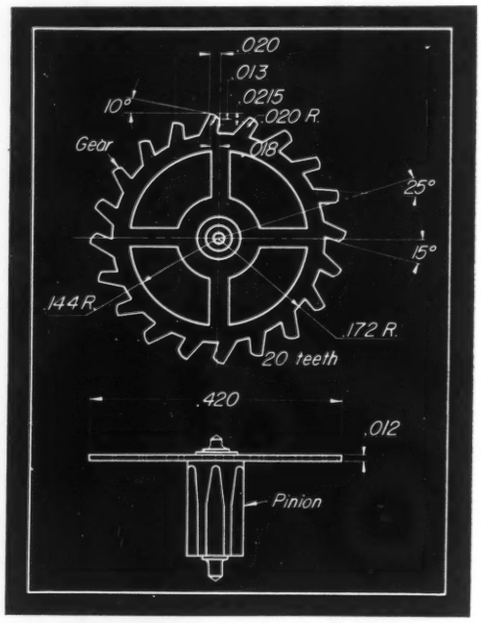


Fig. 4—Dimensions of new escape wheel

be corrected for these losses in a manner to be described. In the derivation, reference is made to *Fig.* 6 and the following nomenclature is used:

r = Mean wheel radius at curved portion of tooth

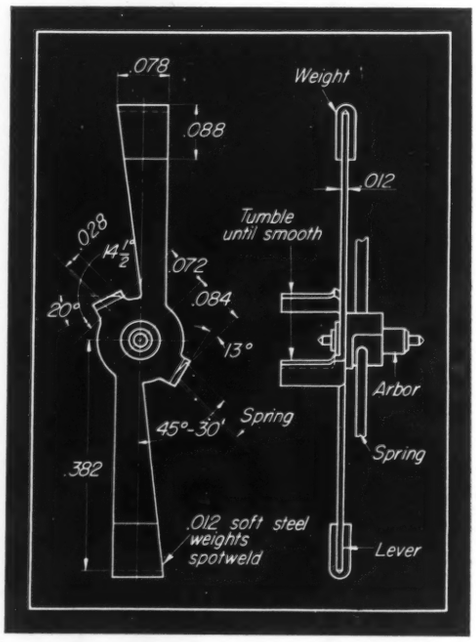
θ = Angle turned by wheel from position where pallet tip *M* leaves point *P* on tooth, radians

α = Angular acceleration of wheel

t = Time, sec

I = Moment of inertia of escape wheel and driving gears

Fig. 5—Dimensions of new escape lever



v = Maximum velocity of pallet
T = Driving torque accelerating wheel

Co-ordinates of the points M, x, and y are not rectangular. They are measured along arcs about C and O, centers of the wheel and lever, respectively. The constant acceleration of the escape wheel leads to an equation for the x-co-ordinate of the tooth

$$\alpha = T/I \quad \ldots\ldots (1)$$

$$x = r\theta = \tfrac{1}{2}\alpha t^2 r = \tfrac{1}{2}Tt^2 r/I \quad \ldots\ldots (2)$$

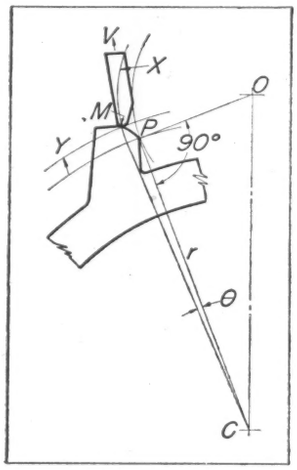
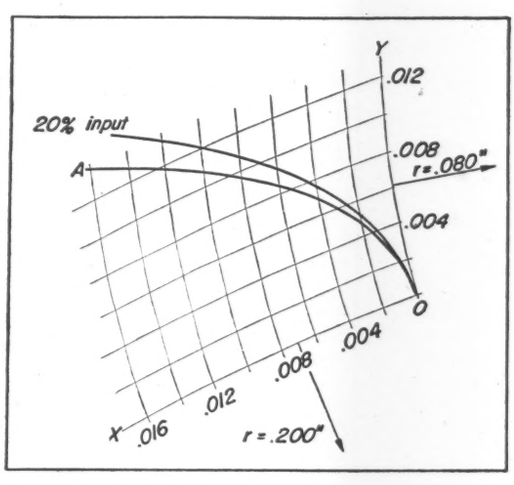


Fig. 6 — Left — Generation of escape tooth form. C is the center of the escape wheel and O is the center of the escape lever

Fig. 7—Below—Calculated tooth form plotted on curved co-ordinates



From the approximation of constant velocity of the pallet

$$y = vt \quad \ldots\ldots (3)$$

hence

$$x = \tfrac{1}{2}(rT/v^2 I)y^2 \quad \ldots\ldots (4)$$

The last equation shows the tooth form to be approximately parabolic (approximate because the co-ordinates are not exactly rectangular). The tooth form is evaluated from Equation 4.

Displacement of the pallet is

$$y = A \sin 2\pi ft \quad \ldots\ldots (5)$$

where A is the amplitude of the pallet oscillation and f is its frequency, 108.8 cycles per sec. The average value of lever amplitude ϕ for the Mark 18 fuse, as manufactured, was $\pm 8°$. The least value which would fully uncover the light exit slot used for dynamic regulation, was $\pm 7°$. The maximum amplitude allowed by stops was $\pm 18°$. Because higher amplitudes enhance the safety of a fuze, the minimum amplitude of oscillation of the new escapement was chosen at $\pm 8.5°$. Using R = 0.08-in. for the radius of the point M on the pallet tip

$$A = R\phi \quad \ldots\ldots (6)$$

$$v = 2\pi fA = 8.1 \text{ in. per sec} \quad \ldots\ldots (7)$$

The moment of inertia of the Mark 18 escape wheel and pinion, plus the inertias of the next two gears of the train multiplied by the squares of their speed ratios to that of the escape wheel, was calculated very carefully. This value, 90 per cent of which was in the escape wheel and pinion, was

$$I = 7.2 \times 10^{-6} \text{lb-in.}^2 = 0.021 \text{ g-cm}^2 \quad \ldots\ldots (8)$$

The inertia of the remainder of the gear train was negligable. The foregoing value of inertia is that which must be accelerated by the fuze torque in the operation of the escapement. The same value of inertia in the new escapement wheel was obtained by making it 0.012-in. thick instead of 0.010-in., its diameter being slightly smaller than that of the original wheel.

Driving torque at the center shaft of the Mark 18 fuze, produced by the centrifugal sectors and starting springs, is 3000 g-cm at the start of flight and 1100 g-cm after 47 sec of flight. Torque efficiency of the gear train under actual flight conditions was calculated and found to be 28 per cent. Multiplying the central-shaft torque values by this factor and by the gear-train ratio (1/275), the actual torques applied to the escapement shaft are 3.1 g-cm maximum, and 1.1 g-cm minimum. The minimum of these torques, together with other numerical constants previously given, were substituted in Equation 4 and numerical values of x and y obtained. These are plotted in *Fig.* 7, curve *A*, on curved co-ordinates having radii of curvature originating at the wheel center C and lever center O.

Correcting for Friction Losses

The tooth form just calculated is based on the assumption of no frictional losses in the escapement. Actually, various losses cause the lever to lose momentum between impulses. In order to maintain the oscillation it is therefore necessary for the tooth to exert torque on the pallets during each driving impulse. This consumes part of the driving torque. The net torque accelerating the wheel equals the difference between the gear-train torque and that absorbed by the lever.

In order to maintain the same 8.5-degree minimum lever amplitude, it is necessary to correct the tooth form for frictional losses. Referring to Equation 4, if v is to remain unchanged, y must be varied inversely as the square root of T, since r and I are fixed.

Losses in the lever have been arbitrarily estimated to consume 20 per cent of the driving torque. All ordinates

of the tooth form must therefore be increased by $1/\sqrt{0.8} = 1.1$. In *Fig.* 7 a corrected tooth-form curve marked "20 per cent input" has been drawn with all ordinates increased 10 per cent over their no-loss values.

In applying the 20 per cent input curve to the wheel shown in *Fig.* 4, the tooth form was approximated by a single circular arc of radius 0.020-in., terminating in a tangential line at 80 degrees to wheel radius. Due to manufacturing tolerances on so small a tooth, this approximation is adequate.

Firing Tests Confirm Redesign

Three pilot lots totaling about 400 escapements were produced with parts as shown in *Figs.* 4 and 5 and put into Mark 18 clock assemblies. These assemblies were given exhaustive laboratory and firing tests. While the laboratory results were excellent, the firing tests were at first disappointing as there were a number of duds and short-time firings. Trouble was traced to cap slippage and a mechanical interference with the W-74 safety-lever plate. Later, when this was corrected, the firing tests confirmed the engineering conclusions concerning the timekeeping ability and reliability of the new escapement.

Characteristics, as revealed by tests on the pilot lots and by subsequent experience in production and use, are summarized as follows:

a. Timekeeping Ability: The effect of driving torque on the rate of the escapement is less than one-tenth that of the original Mark 18 escapement. If the initial timing rate is adjusted correctly, there is no appreciable accumulated timing error. Even when the engagement was purposely mismatched to test the effect of tolerance extremes on performance, the variation in rate after 45 sec of running, as determined by dynamic test, was never more than 0.08 per cent. The accumulated timing error was never more than 0.03 second.

b. Reduction in Cost and Time of Manufacture: In the pilot lots of escapements, and in production, one size of wheel and lever was manufactured and assembled without selection. No hand-matching was used or required. Skilled operators were eliminated in escapement assembly with consequent speed-up of the operation and reduction of cost.

Manufacture Greatly Simplified

Manufacture of the lever was simplified and expedited by swaging the back angles of the pallets, which formerly had been ground, reducing the number of grinding operations and amount of handling. The manufacture and stocking of the wheel was simplified by a reduction from ten sizes and part numbers to one size and part number.

c. Tolerance in Engagement: A series of tests was made with center distances varying from 0.2090-in. to 0.2160-in. (the correct center distance being 0.2125-in.). Over the entire range, the escapement would run and could be regulated to give good timing. This represented a range of engagement which would have required fourteen sizes of escape wheels had the experiment been attempted with the old escapement.

d. Low Operating Torque: It was found that fuzes with the new escapement would run full time with less than one-half the normal operating torque. In the Mark 18 fuze, the available operating torque approaches the minimum running torque for the old escapement.

c. Tolerance in Engagement: A series of tests was made found to be self-starting for separations of the lever and wheel pivots ranging from 0.211-in. to the maximum that could be used. The easier starting of the new escapement contributes to the reliability of the fuze.

Aids Testing on Curves

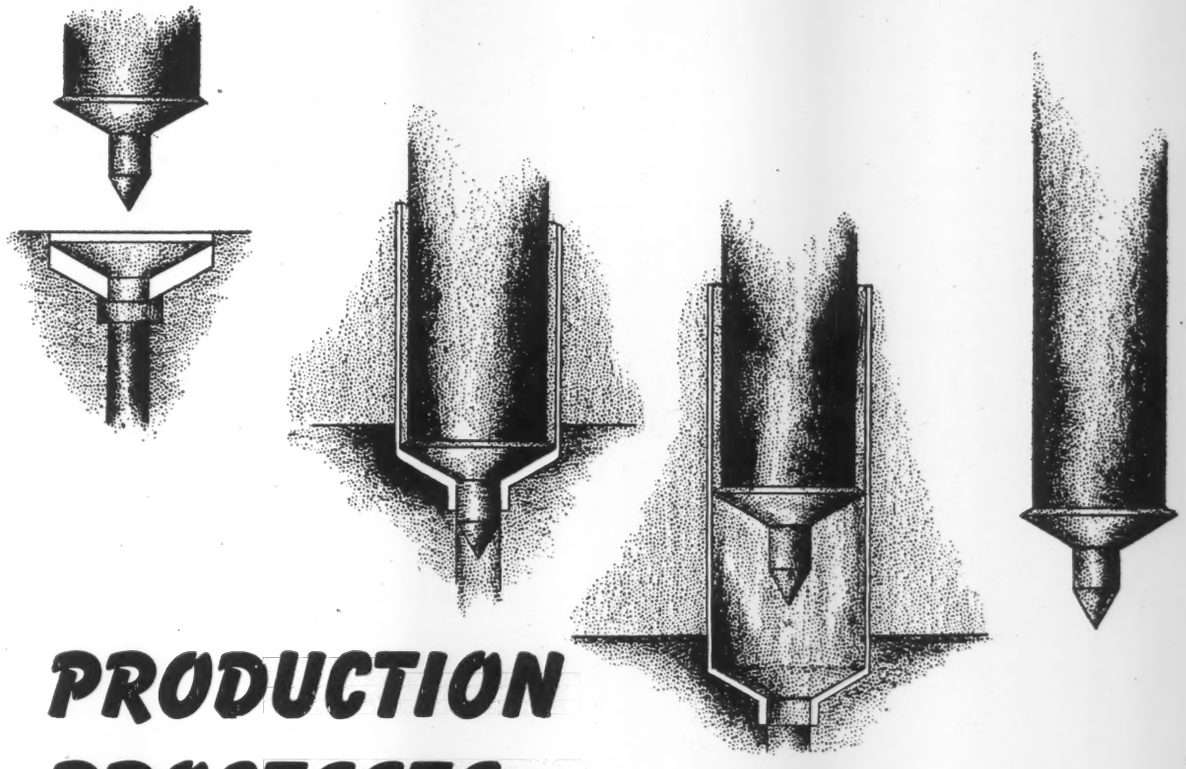
Counterbalancing centrifugal force, a wing structure eliminates side scrubbing of automobile tires on circular test track of U. S. Rubber company's tire proving grounds. With the airplane wing section on one side, cars can travel at speeds not considered safe on public roads. In the photograph below the car is traveling at 90 mph.

On this track which has a one-mile radius, a car normally would be subjected to a side pull of 300 pounds at this speed. This would produce abnormal wear on tire treads, making it difficult to obtain accurate tests.

Friction and Metallurgy

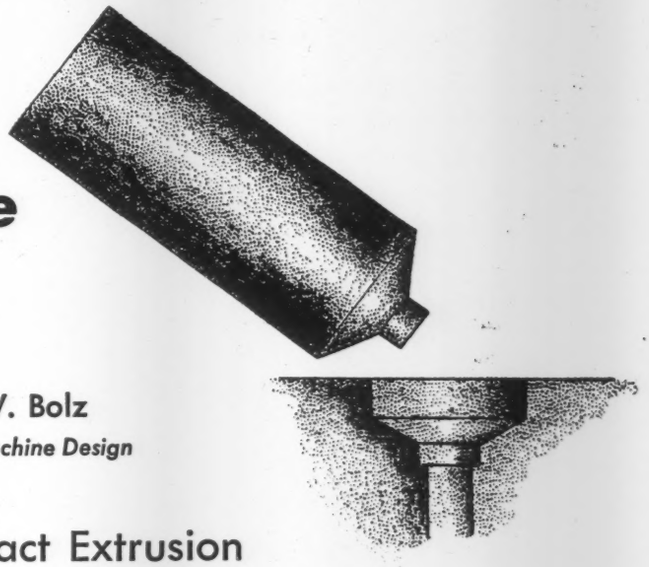
METALLURGICAL as well as geometrical changes can be brought about in lubricated steel surfaces by friction, when two hard steel (or cast iron) surfaces slide over each other. Experiments, made by the engineering division of the Chrysler Corp. to discover changes taking place in steel surfaces during running-in, showed that in all tests the geometry of the surface was changed, the nature of the change depending on the original surface finish of the test specimen. Initially rough surfaces were flattened and smooth surfaces were roughened, while geometrical changes were more conspicuous for rough surfaces than for smooth friction flats.

Test in which hard surfaces of alloy steels were run-in against cast iron revealed in addition that, when two hard surfaces are run against each other, metallurgical changes take place. Transformed material was found to be considerably harder than the martensitic steel of the test samples, and the etching characteristics of the transformed material were markedly different from those of the underlying steel. Initially smooth surfaces took the form of ridge-like eruptions protruding over the surface of the friction flats by several microns (thousandths of a millimeter). Three regions could be distinguished in the transformed surfaces: Bulk steel, transformed material, and intermediate transition region.—*From a paper by Bernhard W. Sakmann, Carter Oil Co., presented at the recent annual meeting of the ASME.*



PRODUCTION PROCESSES...

Their Influence On Design



By Roger W. Bolz

Associate Editor, Machine Design

Part XX–Impact Extrusion

EMPLOYED to a considerable extent in hot forging and especially on nonferrous parts, extrusion of metals both by impact and continuous pressure takes advantage of a peculiar characteristic of these materials. Plastic workability or low resistance to mass deformation, usually achieved by heating above the recrystallization range can, with some of the highly ductile and malleable metals, be attained without heating through the application of tremendous impact pressures.

Plastic flow of metals being impact extruded is not unlike that of a heavy viscous fluid. During extrusion the metal retains its crystalline structure. Except for such metals as lead and tin whose annealing points are around room temperature, plastic flow during extrusion is the characteristic slip-plane movement of cold-working. Heat generated by the impact blow exercises a profound effect and operates to reduce the working pressure during extrusion.

Although when compared to stamping and deep drawing the pressures required and consequent tool duty are much more severe, the advantages of impact extrusion are numerous. Within the size and capacity limitations of present-day equipment, this processing method offers unique possibilities in the design and application of cups, deep shells, or tubular shaped parts, *Fig.* 1. The astonishing reductions which are possible by extrusion often produce with but one blow what by deep drawing may require several operations, including intermediate anneals. Consequently, fewer machines are necessary and output is greater. Common applications include cans, capsules,

flashlight cases, cartridge cases, dry battery cases, tubular parts with straight or tapered walls, radio condensers and shielding pots (*Fig.* 2), etc.

The point where extrusion becomes more economical than drawing depends both on the shell proportions and on shape or complexity. Rectangular or odd-shaped cross section parts which are difficult to deep draw in many instances can be extruded with relative ease, *Fig.* 3. Again, considering ordinary round shells having plain flat bases, extrusion is economically sound when the length exceeds 1.5 times the diameter. Also, in certain cases extrusion can be utilized to advantage as a preliminary operation for deep drawing.

Advantages Merit Consideration

Special advantages of the process make it imperative for the designer to investigate and consider its possibilities. Impact extrusion is relegated primarily to what might be termed tubular or cup-shaped parts, and the thickness and form of the base portion need bear no relation whatever to the wall. Bases may be flat, conical, formed, or embossed, and can be of uniform thickness or may include integral lugs, bosses, depressions, or ribs, *Figs.* 1, 3 and 4. Wall cross-section can be of almost any symmetrical shape, with or without flutes or ribs and normally must be uniform throughout the length.

Essentially, the most versatile method of impact extrusion produces parts by striking a cold slug of metal, *Fig.* 5, approximately the shape and size of the outer cross-sectional dimensions of the desired shell, with a high-speed impact blow. The punch used is of a size and shape required for the inside of the part to be produced while the die cavity corresponds to the external dimensions. The impact, which may be on the order of 50 to 100 tons per square inch of area depending on the ductility of the metal, causes the metal to act as a viscous fluid and flow up and out between the confines of the punch and die. Normally the punch is undercut above a narrow shoulder to assist in stripping. Characteristics not unlike ordinary fluids with respect to orifice effect are present and thus the wall extruded up and around a punch is neither as large in outer dimensions as the die nor as small in internal dimensions as the punch. Wall thickness therefore is aways less than the die and punch clearance but varies according to the sharpness of the corners over which extrusion takes place.

Impact work is usually performed on high-speed crank, eccentric or toggle presses, *Fig.* 6. Press speeds may range from 20 to around 60 strokes per minute, although in many cases speed is limited to 40 to 45 strokes per minute where copious quantities of coolant cannot be used to cool the tools. Actual working stroke usually occupies about one-tenth to one-fifteenth of a second.

Pressures required in extrusion, as noted previously, may run from around 50 tons per square inch for highly ductile, malleable materials such as pure aluminum, lead or tin to 100 tons per square inch for the lower ductility metals and alloys such as brass, copper and aluminum alloys. Base area of parts which can be produced, therefore, depends upon available press capacity. Lead and tin extrusions up to about 3 inches in diameter and 12 inches in length with wall thicknesses from 0.005 to 0.010-inch have been regularly produced, as well as aluminum parts from 0.5-inch to 5 inches in diameter, overall length varying with diameter from about 4 to 10 inches, and minimum wall thicknesses also varying with size from 0.004 to 0.075-inch. Longer extrusions and thicker walls, however, can be produced. A great variety of rectangular and square shell designs, *Fig.* 3, up to around 3 inches have been produced but here again design, the material being worked and press capacity determine the maximum dimensions.

Fig. 1—Some typical cylindrical impact extrusions showing special bottom design

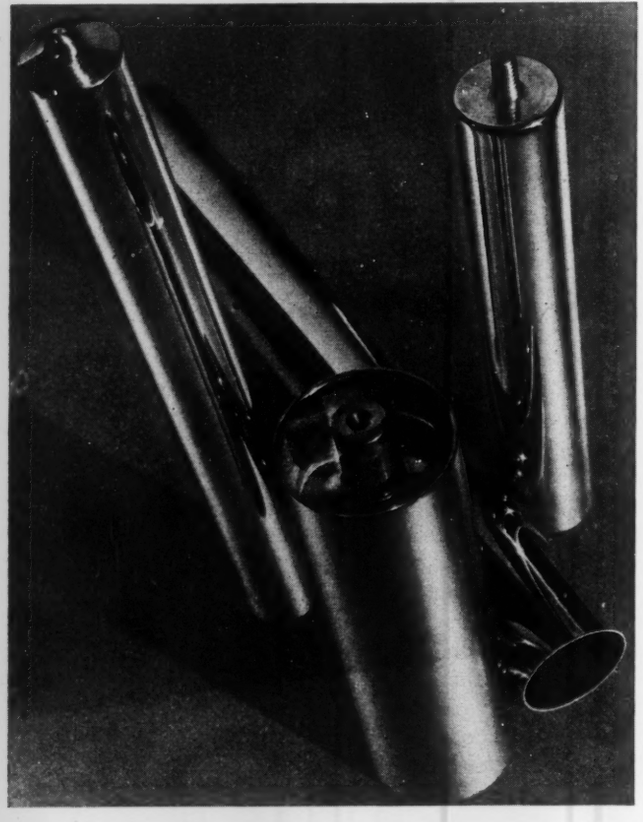
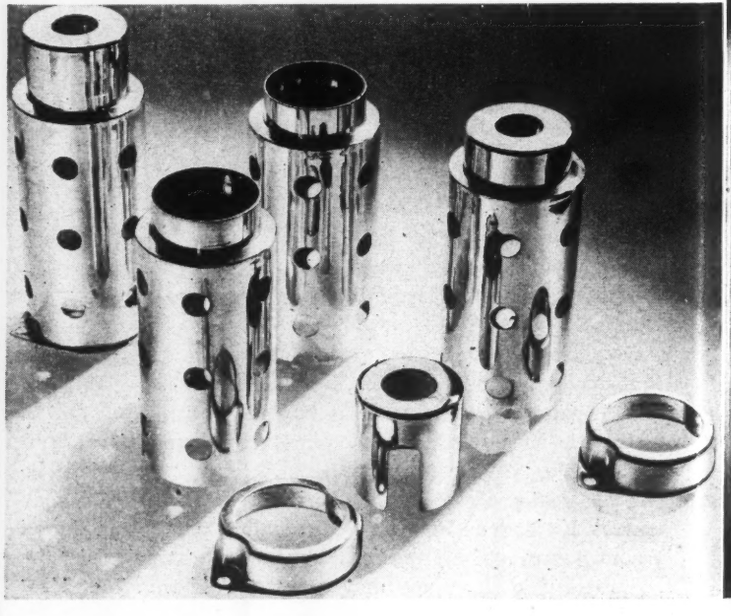


Fig. 2—A group of radio shielding pots impact extruded from aluminum. Side holes require an extra operation



Wichita City Libr

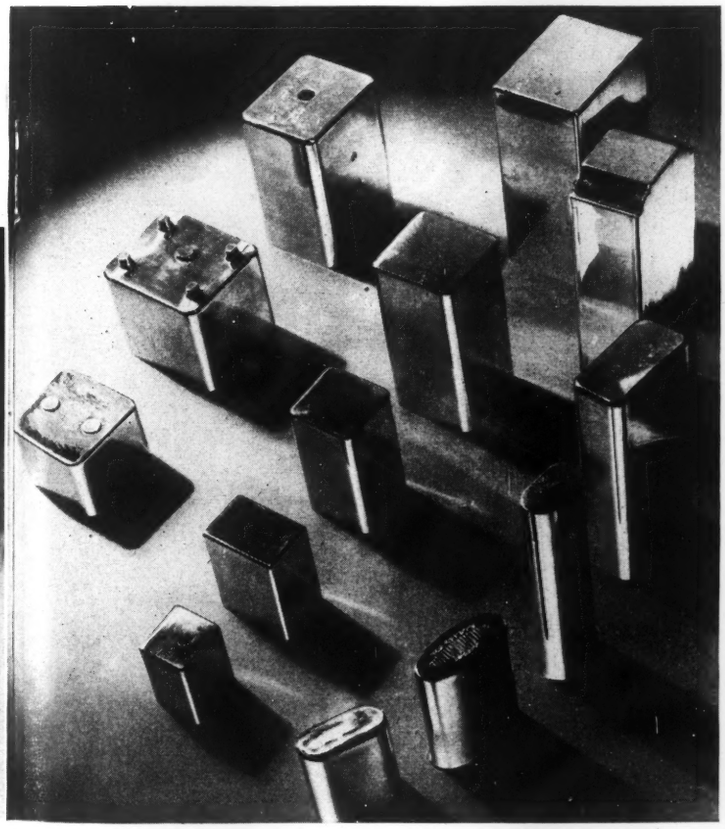
Another method of impact extrusion which makes possible the extrusion of harder metals such as brass and copper is that commonly referred to as the Hooker process. This interesting modification of the impact method, instead of extruding the metal up and around the punch by applying pressure to a plain slug, forces it down through the die by pressure on the wall or flange of a formed slug, *Fig.* 7. Applications of the Hooker process, however, are rather limited and so far have found use only in producing small-diameter, thin-wall copper, brass and aluminum seamless tubes with open or closed ends, cartridge cases, battery cases, etc.

The outstanding advantage of the Hooker process is that of producing cylindrical parts with tapered walls, *Fig.* 7, in but a single stroke, a feature not possible with regular impact work. Also, owing to the character of the metal movement in the Hooker process, the pressure required is less intense and, to further relieve tool duty, special preformed and annealed blanks are usually employed. Unlike regular impact work, though, the base of such parts must be plain, the forging action of the punch against the die bottom not being available.

Production speed in extruding downward is rather fast for most parts—speeds around 125 strokes per minute being used. In some cases a separate die-trimming operation is not necessary, for a new slug forces out the previously finished part. Economical production runs usually range around 10 to 15 million pieces.

Tubular parts made by this method run from about 0.187 to 0.375-inch diameters with wall thicknesses from 0.004 to 0.010-inch. Heavier walls can be produced but usually can be made more economically by deep drawing. Lengths extruded generally range up to 12 inches and the maximum feasible is about 14 inches.

Fig. 3—Square, rectangular and odd cross-section shells can be readily extruded with special bottom designs



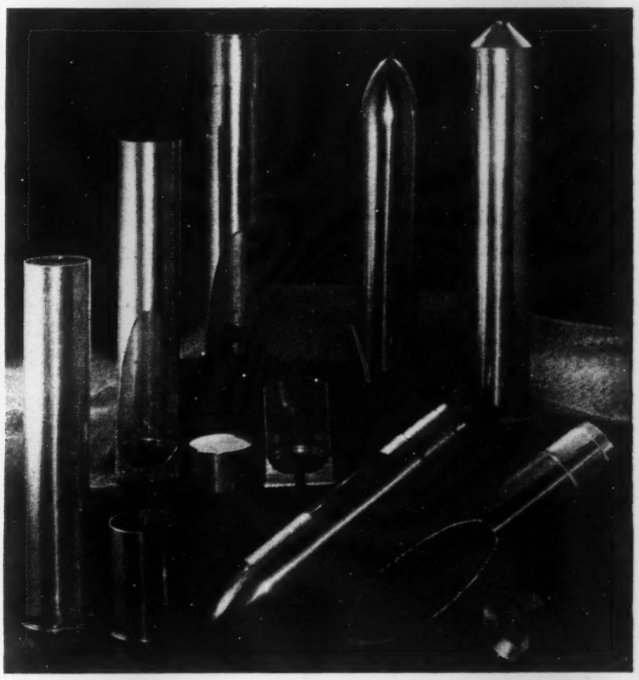
DESIGN: As a rule impact extrusion should be considered primarily when a part requires a heavy bottom with a relatively thin side wall or when the heavy bottom requires integral studs, bosses, necks, or cavities inside or out, *Fig.* 8. Another criterion for design is cross section —parts with square, rectangular, oval, or combinations of such shapes in section being particularly suitable. When wall thickness in section must vary, including longitudinal ribs inside or out, when longitudinal wall thickness must taper, or when the ratio of length to diameter is high, the extrusion method should be carefully considered.

Punch Strength Limits Length

Generally, maximum shell length is about six times the inside diameter of cylindrical parts. Column strength of the punch is usually a limiting practical factor. In designing for a combination of several of the preceding variations mentioned, a limiting factor in bottom thickness enters into the picture, especially when wall thickness varies in cross-section. Sufficient metal must be provided to fill out the walls, hence it is desirable to have the finished bottom 0.010 to 0.040-inch heavier than the greatest wall, depending on production conditions. Bottoms for the Hooker method must be plain but can be any desired thickness, and side walls, as noted previously, can be tapered as desired within practical punch limitations.

Owing to punch length in most cases there is a tendency toward float during extrusion. To minimize this cause of wall variation, symmetry in design is highly desirable as well as attention to bottom design. Cross-sectional wall design should be symmetrical as to wall variations and ribbed sections to equalize extrusion forces, *Fig.* 9, and, likewise, bottom design should be symmetrical as possible to assure regular flow of metal, *Fig.* 9. Tapering

Fig. 4—Group of aluminum impact extrusions showing further variations in bottom design commercially practical



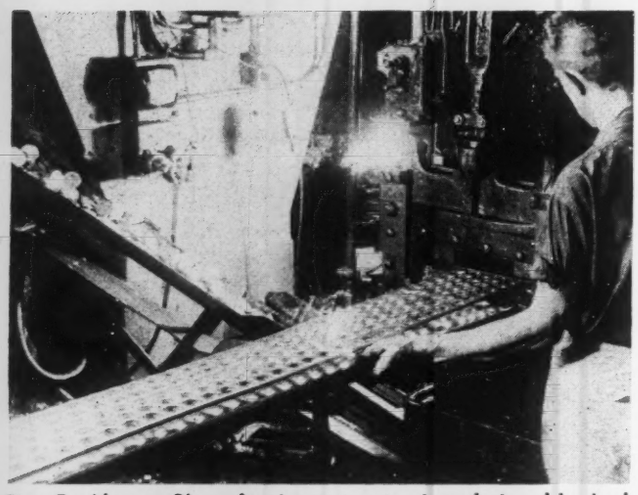
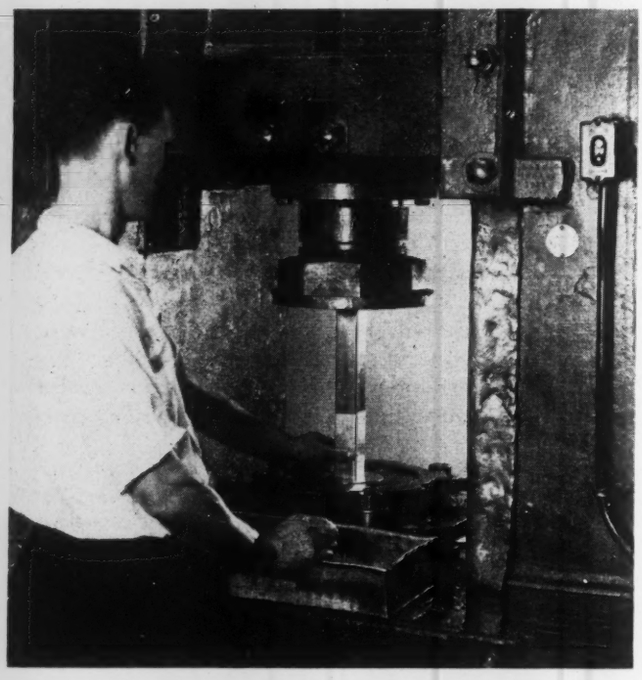


Fig. 5—Above—Slugs for impact extrusions being blanked from plate in a multiple die

Fig. 6—Below—Rectangular aluminum impact extrusions being produced on a typical high-speed mechanical press



or beveling the punch nose also assists centering of the punch and helps reduce the pressure of extrusion. A standard punch bevel of 15 degrees has been adopted for flat bottoms while a 120-degree included angle is considered the ideal for cylindrical parts, *Fig.* 9. Complex shapes may require consultation with the producer to assure satisfactory production. To assure an even, smooth flow of metal at the outer edges, corner or edge radii should be at least 0.031 to 0.062-inch.

Pressures as high as 100 tons per square inch of bottom area have been recorded in production of parts. Pressures increase rapidly from a minimum with soft, pure metals and small parts to a maximum with large parts or work-hardening metals or alloys. As bottom area increases, the metal is required to travel further before extrusion, hence a rectangular bottom with the same area as a round one requires more pressure. Also, more pressure is required to extrude a shell with a thin wall than one with a thick wall. It is well, therefore, to avoid specifying minimum wall thicknesses wherever possible, *Fig.* 10.

Holes in projecting lugs or nozzles can often be produced or pierced during the extrusion process. Such holes, however, must be coaxial or centrally located—all other holes must be produced by a secondary operation.

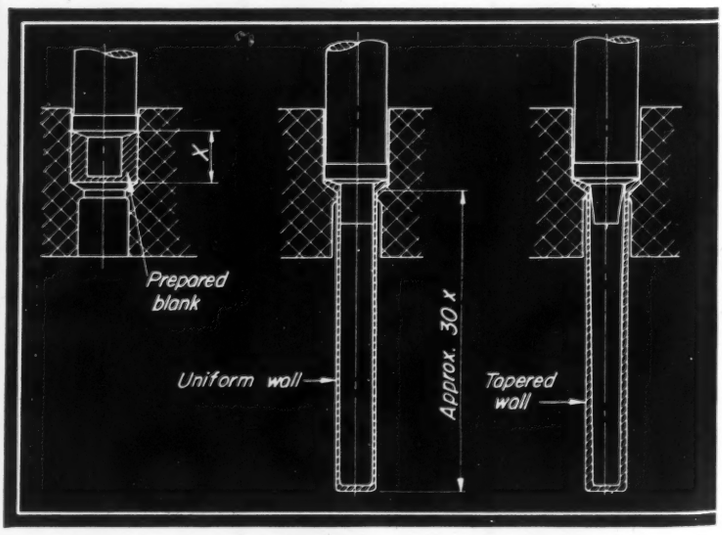
With Hooker extrusion, the flatter the punch angle and the steeper the die angle, *Fig.* 7, the easier the flow of metal. Good practice dictates a 20-degree angle on the punch nose and a 30-degree angle in the die. Where push-through, continuous extrusion is used these angles are usually reduced to 15 degrees each. Relation of wall thickness of a blank to wall thickness of the finished tube is usually limited to the range of 4 to 1 and 25 to 1.

MATERIALS: Cold impact extrusion applications began with tin. To date the method has also been successfully applied to parts of lead and aluminum. Zinc is usually handled with a little preheating—about 300 F—to get into the most ductile range. With the Hooker process copper and brass can be readily worked from cold slugs although it is also well adapted to producing parts from lead, tin and aluminum. Some work has been done experimentally on hot impact extrusion of small copper parts but it has not been widely commercialized.

In general, to assure maximum workability at lowest impact pressures, pure metals are necessary, especially with those metals that strain harden quickly. Purity of zinc is of much importance, a special grade 99.99 per cent pure is usually employed although an alloy with 0.6 per cent cadmium is used for dry battery cells. Zinc has the added advantage of ease of soldering, a characteristic of value in many electrical applications.

In aluminum, 99.75 per cent (minimum) commercially pure 2S is preferable owing to longer tool life, although 99.5 per cent pure metal can be used. Shells with heavy walls can be produced in aluminum alloy A51S, 53S, and 61S. While the high physicals of 17S limit workability severely, occasionally it can be extruded successfully. Approximately full-hard properties are developed in working aluminum, which produces parts amply strong for most

Fig. 7—A modification of impact extrusion, the Hooker process forces material down through the die rather than up around the punch



applications. If contours of bottom design are severe or material difficult to extrude, two operation can be used.

When copper is specified, a 99.9 per cent pure electrolytic grade is employed. Along with copper, 70/30 cartridge brass as well as aluminum also find use in the Hooker method. These metals show the effects of severe cold-work and consequently must be annealed both before and after extrusion if ductility is necessary in the extruded part for further working.

TOLERANCES: As can be readily seen, conditions of processing are conducive to high accuracy during useful tool life. Wall thickness and diameter can usually be held to plus or minus 0.001 to 0.002-inch while bottom thickness can be held within plus or minus 0.003 to 0.005-inch depending upon design complexity.

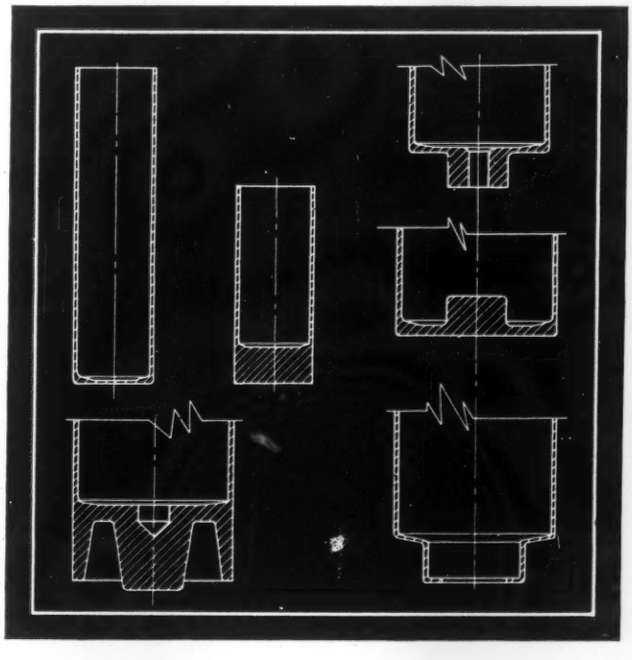
REPRINTS of the first fifteen parts of this series are now available. Particulars can be had by writing MACHINE DESIGN'S Book Dept.

Parts have been produced by the Hooker process with walls as thin as 0.004-inch, accurate to plus or minus 0.0005-inch. Large parts with heavier walls, normally, should have wider tolerances. Bottoms by this process depend primarily upon the method of blank manufacture, preparation of the blank usually including a cupping and stamping operation to size the bottom.

Erosive action on the narrow edge of the die over which extrusion takes place creates severe die wear and consequently the wider the tolerances specified, the greater the die life and the lower the unit cost per piece.

Collaboration of the following organizations in the preparation of this article is acknowledged with much appreciation:
Aluminum Company of America (*Figs.* 1 through 6) ..... Pittsburgh
Chase Brass & Copper Co. ..... Waterbury, Conn.
Clifford Mfg. Co. (*Fig.* 7) ..... Boston
Revere Brass & Copper Inc. ..... Rome, N. Y.

Fig. 8—Typical designs well suited to impact extrusion



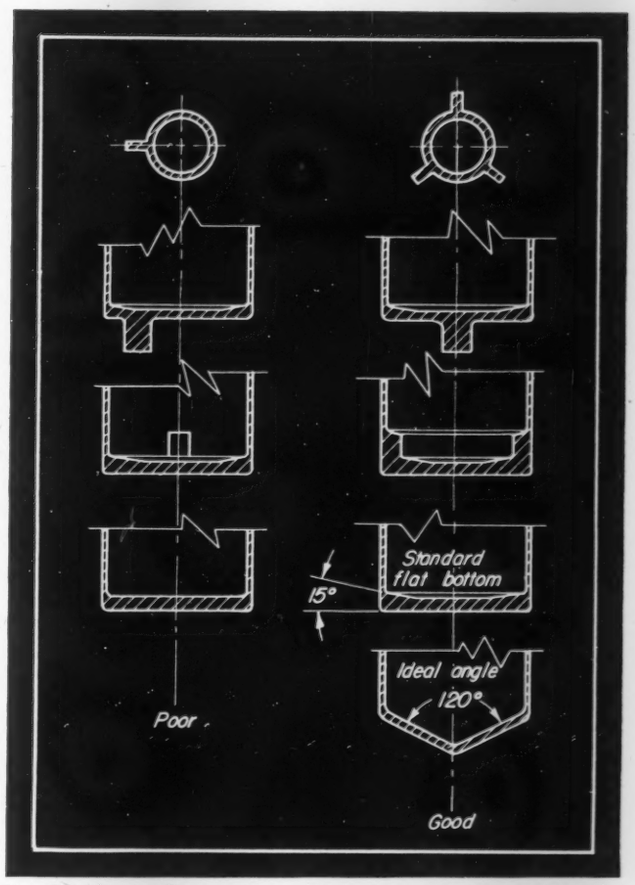
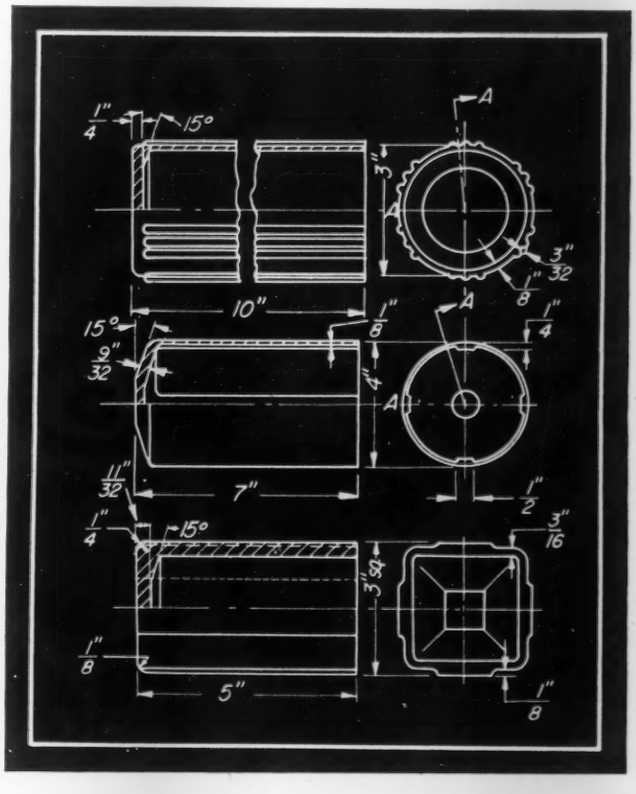
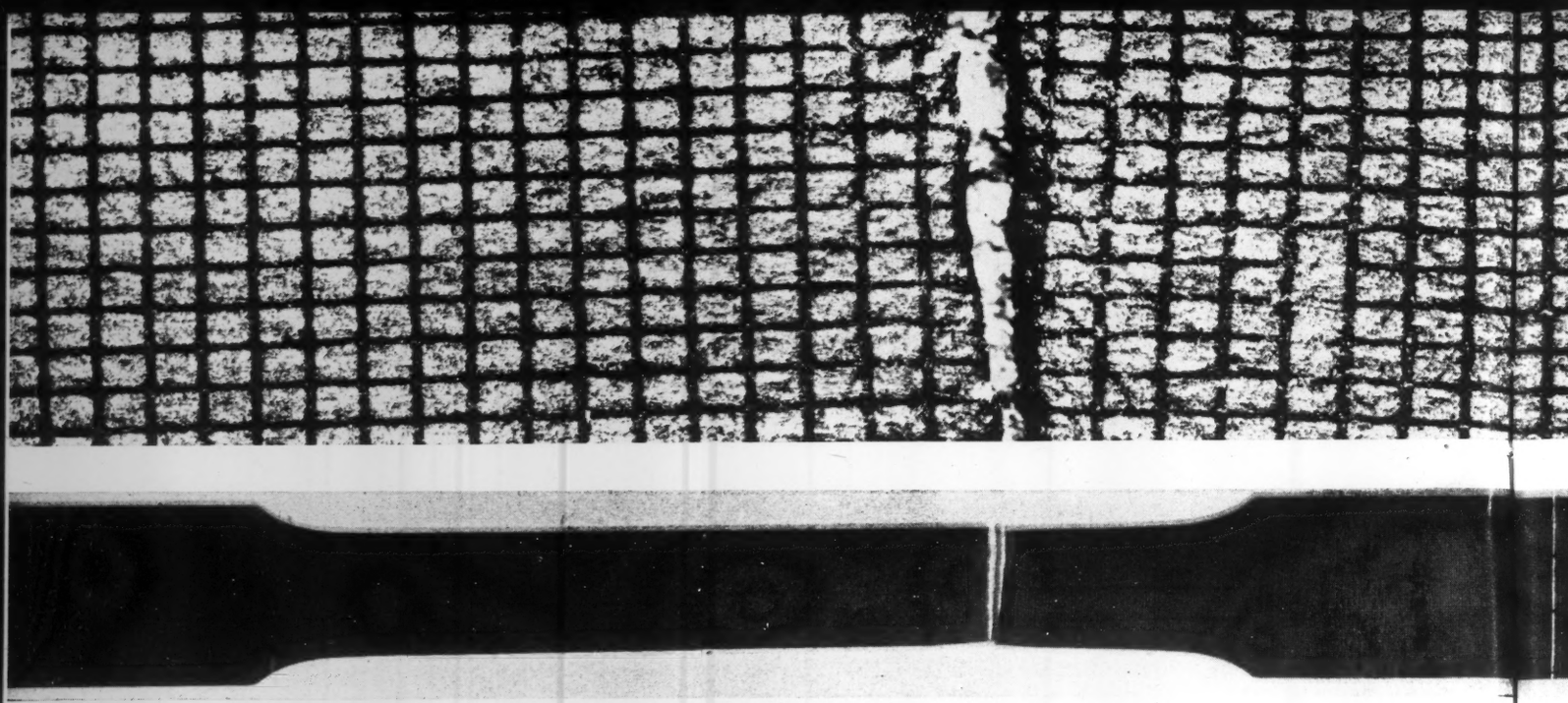


Fig. 9—Above—To assure maximum accuracy extrusion designs should be symmetrical as possible

Fig. 10—Below—Heavy walls provide maximum economy in production but should be used in preference to minimum thickness only with proper consideration for metal economy





Photogrid Process

applied to problems in machine design

By G. A. Brewer
Consulting Engineer
Laguna Beach, Calif.

PHOTOGRID process, used for the determination of plastic strains over almost any size gage length, is particularly useful in the study of strains in the neighborhood of discontinuities such as holes in a structure, *Fig.* 1, or strains encountered during forming operations, *Fig.* 2.

In the case of the simple tension coupon the elongation is normally determined with a strain gage covering a distance of two inches but, from *Fig.* 3, it can be seen that the ordinary strain gage presents only an average picture of the metal's behavior. The elongation at the break, which has been found to be of importance, is lost in the ordinary test.

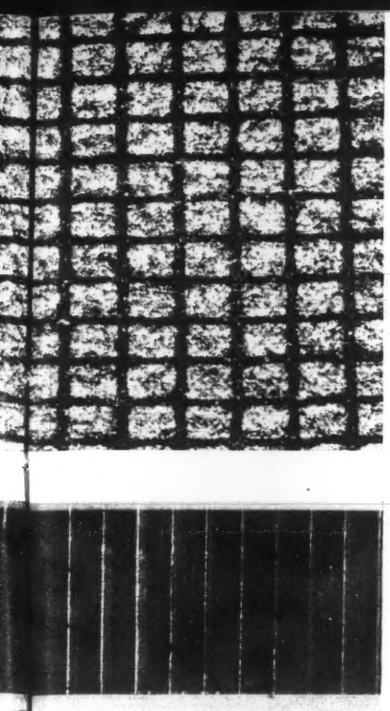
Ability of metal to bend to a small radius without cracking has been found to be a function of the metal's ductility as measured over small gage lengths adjacent to the plane of tensile fracture (5 and 7).* From photogrid studies it has been found that the distribution of strain along a tensile specimen is essentially uniform up until the load where necking begins, *Fig.* 4.

Photogrids, in the case of deep drawing, are used to compare the plastic strains encountered in a drawn cup with those of a wedge coupon; a comparison of the strains is shown in *Fig.* 5 and the correlation shown in *Fig.* 6. Photogrids are also used to determine elongations in sleeves drawn and redrawn for several stages (9).

In the field of machine design it is of interest to study the distribution of strain in metal adjacent to a hole in a bar under tensile stress above the yield. In some forged billets of aluminum alloy the presence of a hole in a bar under tension has been found to lower the ultimate stress appreciably. Practice, in the design of tension lugs, neglects the fact that the stress is nonuniformly distributed across the metal section and assumes that the ultimate breaking stress of the metal is uniform across the net section. However, investigation of the strains across the net area of a lug in tension (6) disclosed that the strain distribution far into the plastic range still roughly paralleled the elastic strain (and elastic stress) distribution across the net area, *Fig.* 7. The *stress* distribution in the plastic range was nearly uniform in accordance with simple lug theory.

For a hole in a tension member, photogrid studies reveal the fact that here too the strains in the plastic region, even at failure, are distributed parabolically across the

* Numerals in parentheses refer to references listed at end of article.



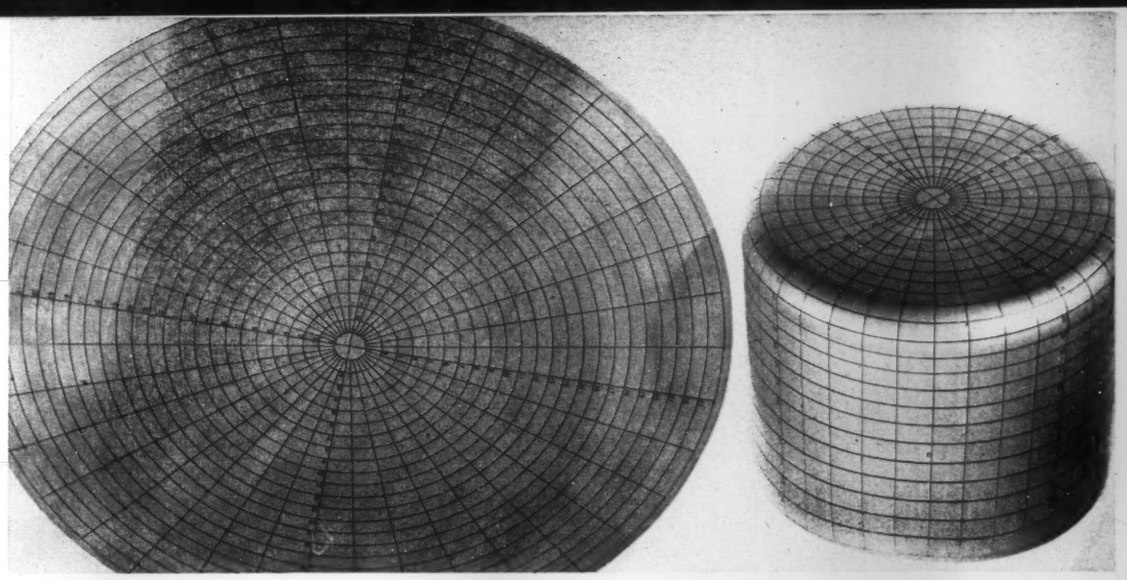


Fig. 1—Left—Fracture across net area in tensile coupon. Elongation of 100 lines per inch grid pattern shows extent and area of plastic flow

Fig. 2—Above—Polar grid employed to show strains resulting from deep drawing operations. Concentric rings are ¼-inch apart with 10-degree spacings

section closely similar to the elastic strain (and elastic stress) distribution, *Fig.* 8. Again, however, the stress in the plastic region is essentially uniform across the net section of the tensile bar, due to the trapezoidal shape of metallic stress-strain diagram.

The photogrid process consists of spraying a photo-sensitive glue onto the surface of a piece of metal and then, by exposure to light, printing a gridwork of lines on the surface of the specimen.

Spraying emulsions are made as follows (2):

Ingredients	Parts by Weight
Water	28
Photoengravers glue	4
Ammonium bichromate	1
Strong ammonia water	¼

This is mixed with four parts of water and four parts of alcohol for spraying.

To receive the glue spray, it is necessary that the surface of the metal be chemically clean. This may be accomplished by rubbing the surface with a light pumice or by dipping the metal into an etchant. Before spraying, the metal specimens are placed in a warm container, preferably equipped for fume removal. Temperature of the spraying cabinet should be about 100 F.

Spraying may be accomplished with a small size paint spray gun. The best coating for clarity of detail is produced by four or five light coats, with a few seconds between. Spraying may be carried out in moderate light but after the coating is deposited it is desirable to print the samples at once or store them in a light-tight container.

After the photo-sensitive coating has been applied to the specimen it is printed by contact with a glass or film negative containing the gridwork to be imprinted on the metal surface. Printing is accomplished in a vacuum printing frame using an arc light for a light source. Exposures vary from 3 to 8 minutes.

When exposed, the metal sample is dipped in cold water to dissolve and wash off the unexposed glue, and then placed in a pan of hot water and dye. The glue grid-

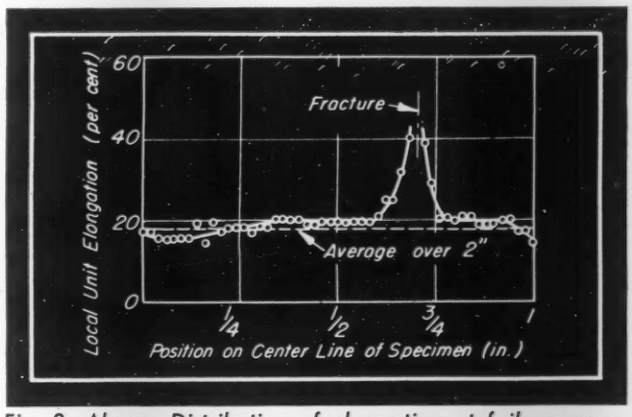
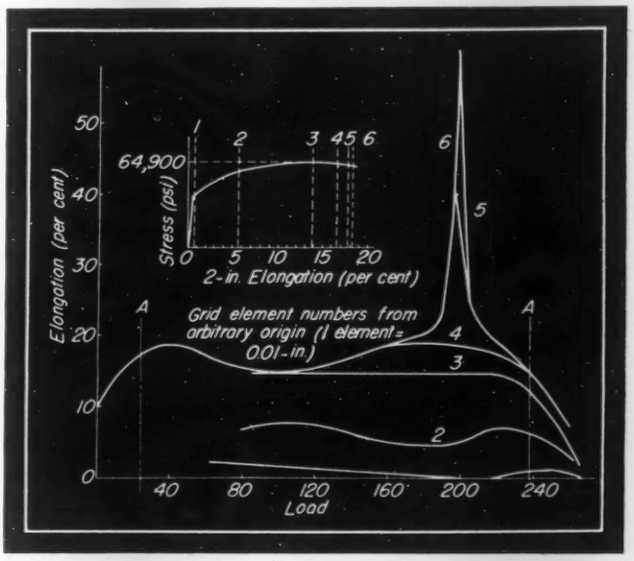


Fig. 3—Above—Distribution of elongation at failure measured for 0.02-inch gage, on 24 ST aluminum tensile coupon

Fig. 4—Below—Distribution of elongation as a function of load in tensile coupon of 0.064-inch 24 ST aluminum, cross grain. Edge of fillets is indicated at A. Courtesy, Journal of Aeronautical Sciences



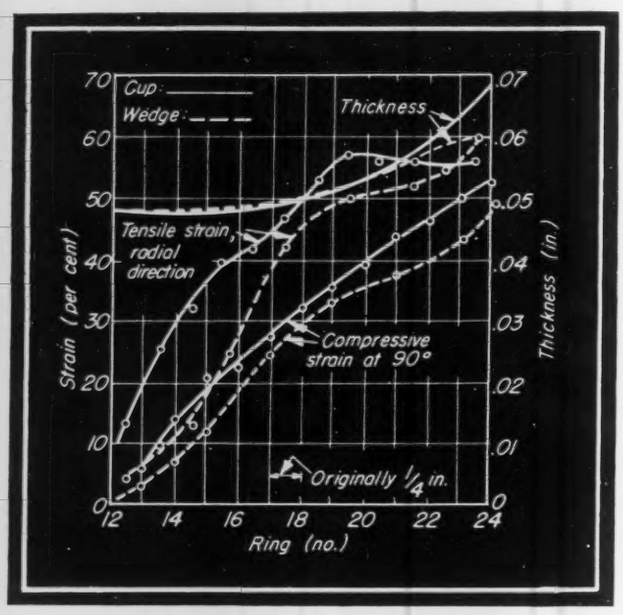
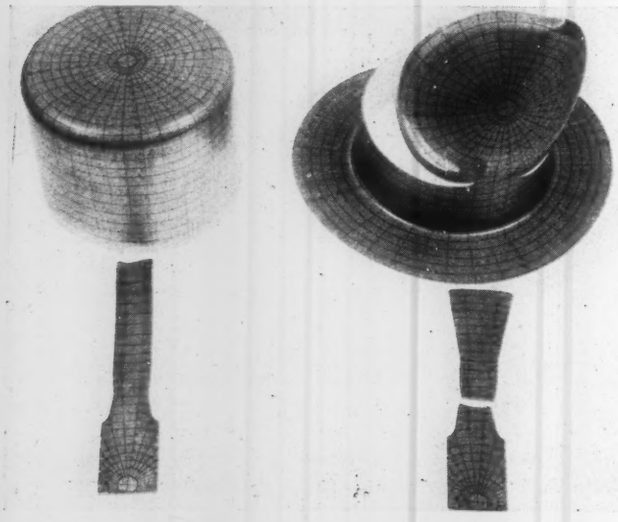


Fig. 5—Above—Comparison of measured strains in drawn cup and wedge of 24 SO aluminum 0.051-inch in thickness

Fig. 6—Below—Grid patterns on drawn parts and their wedge coupons. Measured strains in the cup and wedge for each grid section in the cup side are shown in Fig. 5



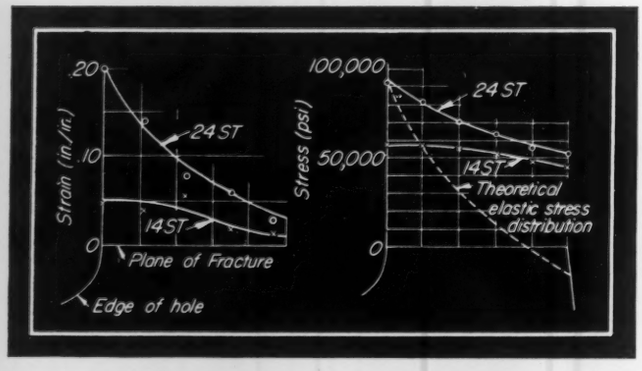


Fig. 7—Above—Strain distribution in thin lugs measured from photogrids after failure, left. In the set of curves, right, is shown calculated true stress at failure

work remaining on the sample absorbs the dye and the image becomes visible. For maximum durability the grids may be finished by soaking for five minutes in a 10 per cent formaldehyde solution or covered with a coat of clear lacquer or both.

Grid negatives and positives may be prepared in a number of ways, the preparation being a function of the final result desired. Common types of grids are rectangular with line spacings between 0.01 and 0.10-inch, *Fig.* 1, and polar grids having 10-degree radial spacing and ¼-inch annular rings, *Fig.* 2. A rectangular 100-line per inch grid may be prepared by photographing an ordinary 100-line engraving screen through a ¼-wave plate. This produces a negative with diagonal lines 0.01-inch apart; by doubling this print at 90 degrees on another plate, a 100-line per inch rectangular grid is obtained. Larger grid spacings may be obtained by lofting out the desired grid about three times final size on an enameled aluminum sheet and making a photographic reduction onto the negative. The polar grid shown in *Fig.* 2 was made in this manner. Negatives are preferably made of glass, Hammer Plates or Eastman Contrast A. H. In cases where extreme accuracy is not necessary, Kodalith film will be found satisfactory. A Kraft-Tint 60-line per inch rectangular grid on celluloid may sometimes be used, photographically reducing the grid to 100 lines per inch if desired.

References

1. "Determination of Strain Distribution by the Photogrid Process"—G. Brewer and R. B. Glassco, *Journal of Aeronautical Sciences*, Nov., 1941, Page 1.

2. "Photogrid Printing"—K. Cornell, *American Photography*, Nov., 1942, Page 16.

3. "Measurement of the Drawing Properties of Aluminum Sheet"—G. Brewer and M. M. Rockwell, *Metal Progress*, May, 1942, Page 663.

4. "Studies of Plastic Flow Problems by Photogrid Methods"—C. P. O'Haven and J. F. Harding, *Proceedings Experimental Stress Analysis*, Vol. II, No. II, Page 59.

5. "Measurement of Strain in the Plastic Range"—G. Brewer, *Proceedings Experimental Stress Analysis*, Vol. I, No. II, 1943, Page 105.

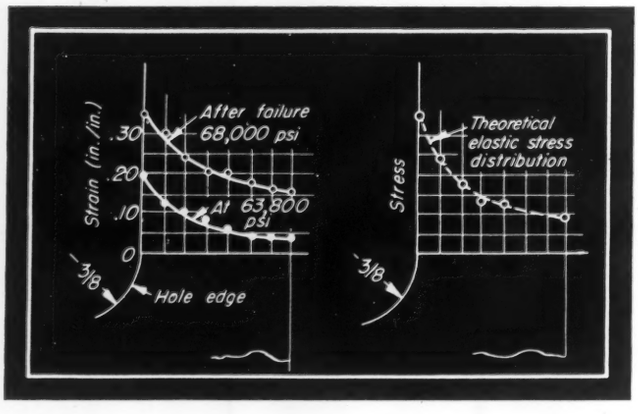
6. "Brittle Failure of Hogged-Out Fittings from 14 ST Billets"—G. Brewer and H. C. Ihsen, *Metal Progress*, March, 1946, Page 566.

7. "Effect of Bend Width upon Minimum Bend Radii"—G. Gerard, *Journal of the Institute of Aeronautical Sciences*, April, 1946, Page 161.

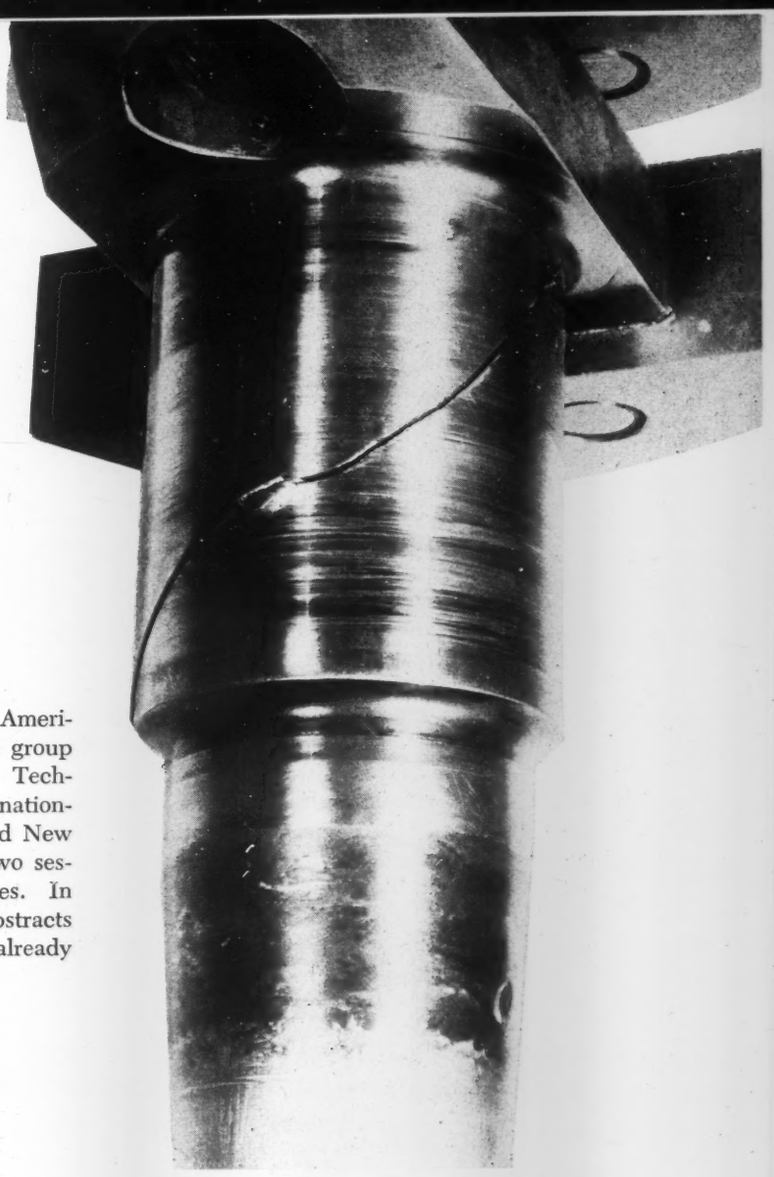
8. "The Effect of Notches on Limiting Strain", Douglas Santa Monica Report 10841. Also "Notch Effects in High Strength Aluminum Alloy Spar Caps"—D. L. Moseley, Preprint L. A. Section Institute of Aeronautical Sciences, May 4, 1945.

9. "Technical Developments in High Production Sheet Metal Forming"—W. Schroeder and T. H. Hazlett, *SAE Journal*, May, 1943, Page 170.

Fig. 8—Below—Strain and theoretical elastic-stress distribution across transverse section at hole in a 24 ST coupon, 1½ inches wide and ⅛-inch thick with a ¾-inch hole in the center of the coupon specimen



Highlights from Machine Design Group Meeting



SLIGHTLY over a year ago there was formed within the American Society of Mechanical Engineers a Machine Design group for the purpose of advancing the interests of designers. Technical sessions sponsored by the group were held at three of the national meetings of the Society during 1946, in Detroit, Boston and New York. At the latest of these, five papers were presented at two sessions, abstracts of which appear on this and the following pages. In addition to the significant information they contain, these abstracts will be of interest in showing MACHINE DESIGN readers not already familiar with this group something of the scope of its activities.

Stress and Strength of Machine Parts

By Charles Lipson

The Detroit Testing Laboratory
Detroit

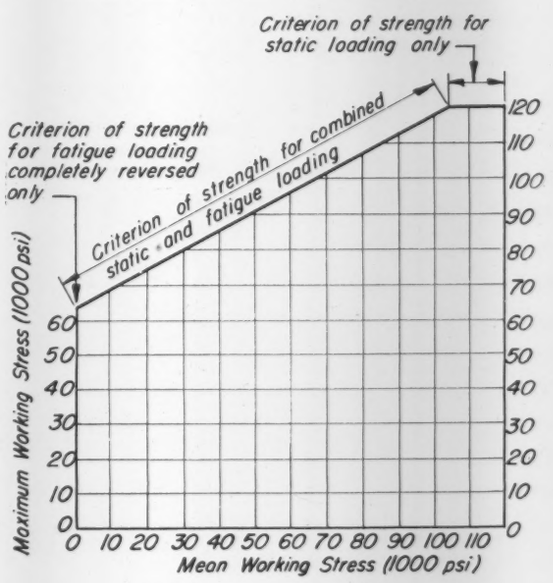
Fig. 1—Above—Result of failure to provide the proper balance between stress and strength

RATIONAL approach to a design problem involves basic recognition of structural requirements. The designer should regard these requirements not as a check on a design otherwise conceived but as a legitimate factor running parallel to the requirements of performance. The concept of a machine part as something created to fulfill certain functions should go side by side with an effort to make this part sufficiently strong to perform these functions.

Greater recognition also should be given to the fact that structural problems involve determination of two factors: Stress and strength. By stress is meant here the working stress imposed on a member by service loads, assembly conditions and by fabrication. This stress can be static, dynamic or a combination of the two. Static stress can result from conditions such as the driving torque of an engine, preload of a suspension spring or the residual stress produced in a shaft by straightening. Dynamic stress can result from the torsional fluctuations of a crankshaft, flutter of a fan or the reaction of car suspension members to road irregularities. Stress also includes the so-called residual stresses resulting from methods of fabrication such as forging, casting, cold-straightening, shot-peening, etc.

By strength is meant the allowable stress—the maximum stress which the material in its fabricated form can sustain when sub-

Fig. 2—Below—Chart for determining allowable stress (strength) for typical alloy steel



jected to working stress, that is, to service loads, assembly conditions and to fabrication. Strength, as defined here, takes into account hardness of the material, size of the member, surface conditions, type of service loading, etc.

In determining strength the following factors must be taken into consideration:

(1) Hardness of the Material: The relationship between strength and hardness is one of the basic relationships in structural considerations. Static strength (ultimate strength and yield point) varies with hardness. Fatigue strength also varies with hardness, the relationship being very much a function of the surface finish.

Effect of Size on Strength

(2) Size of the Part: Presumably, static *unit* strength of a part is independent of its size. Fatigue strength, on the other hand, varies with size, larger members generally having lower strength than small members.

(3) Life Expectancy of the Part: In determining the strength of the part the length of service to which the part will be subjected should be also considered. Thus an automobile crankshaft operating at 3600 rpm may accumulate several million cycles of reversed torsional loading in a few days. In this case the endurance limit corresponding to 10^7 cycles will be the correct criterion of strength. On the other hand a transmission low gear is likely to accumulate only 100,000 cycles in the entire life of an automobile. In this case the strength criterion will be the fatigue strength corresponding to 100,000 cycles.

(4) Loads Acting on the Part: The criterion of strength will also depend on the type of loading conditions to which the part is subjected in service. If the load is static the criterion of strength will be the yield point whereas if the load is dynamic and completely reversed it will be the endurance limit. If it is a combination of a static and a dynamic load it will be the endurance limit corresponding to the loading condition.

Finish Affects Fatigue Strength

(5) Type of Surface Finish: The type of surface finish has no appreciable effect on the static strength of the part, (at least at low and medium hardness) but has a pronounced effect on its fatigue strength. For a given steel and given core hardness, polished surface and as-forged surface may differ by several hundred per cent in their fatigue values.

Once the stress and strength have been determined the question arises as to the means for determining the balance between the two. A chart of the type shown in *Fig.* 2 can be used for this purpose. Maximum working stress is plotted for the corresponding mean working stress. This in turn is compared with the allowable stress as defined on the chart by the top boundary line. Similar charts* have been constructed for different material hardnesses and different surface finishes.

This comparison, in effect, represents the balance between stress and strength. If the former is smaller than the latter the design presumably is structurally satisfactory. If the opposite is true a failure is likely to occur.

* Noll, G. C. and Lipson, C.—"Allowable Working Stresses," *S.E.S.A. Proceedings*, Vol. III, No. 2, 1946, Page 89.

Design of Large Broaching Machines

By George R. Squibb

The Cincinnati Milling Machine Co.
Cincinnati

SOME of the factors influencing the proper design of surface broaching machines in the large class of 10 to 100 tons broaching capacity, popularly used in the automotive and associated industries, are discussed in this paper. This type of machine is also applicable to any type of industry involving the surface finishing of large parts in high production.

In order to study the basic problems involved, an experimental machine, *Fig.* 3, was built by The Cincinnati Milling Machine Co. Factors under consideration were: Power required, possible speed, deflections involved, hydraulic pressures required, production possibilities, design of work-holding mechanisms, design of cutting tools, and tool life obtainable.

A large hydraulically operated ram is provided in this machine for carrying the cutting tools. A retracting type table is provided also so that the parts can be presented to the broaching tools during their forward stroke, and retracted at the end of the broaching stroke in order to give clearance for the broaching tools during their return stroke. By means of a number of recording gages permanent records were made throughout the cutting stroke for the following characteristics: Required horsepower, fixture deflection, ram speed, and hydraulic pressure.

Fixture-Holding Mechanism Design

As important as the machine itself is the design of the fixture-holding mechanism. Design of the broaching tool is of extreme importance in order to obtain the end results of surface finish, accuracy, and long tool life.

Due to the large size of these machines and in consideration of the limited quantity in which they are produced a fabricated bed is used instead of a casting. This welded bed weighs approximately 35,800 pounds. After fabrication the bed is set up in an annealing furnace, where it is aligned for proper positioning, and then completely stress relieved. The fixture framework is fabricated also and consists of four vertical members welded to a horizontal plate. This structure, too, is stress annealed and the unit is keyed and bolted to the main bed frame work. *Fig.* 3 shows the completed machine for broaching cylinder blocks.

Approximate net weight of this equipment is 140,000 pounds. In order to support this weight, a 24-inch thick concrete base is recommended. The machine is supported on 16 hollow leveling screws, the holddown bolts being in the center of the screws, thereby eliminating any possibility of inducing stress into the machine frame work. The machine is also anchored at each end to the concrete to prevent movement of the machine when the heavy ram starts and stops. Such a machine should be leveled periodically; in the first six months of operation it should be leveled monthly. This maintains the proper bearing condition and eliminates any sagging or twisting which may occur due to settling of the floor or change in the machine structure itself.

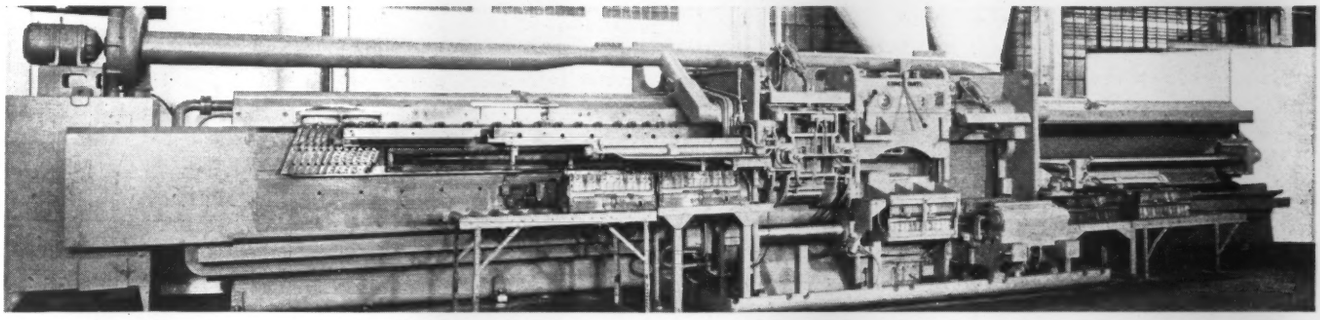
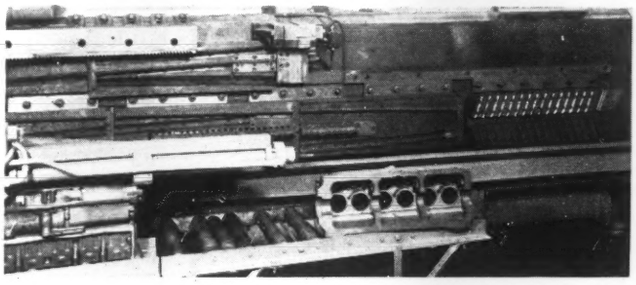


Fig. 3—Above—Front view of large hydraulically operated machine for surface broaching cylinder blocks

Fig. 4—Below—Broaches finish five surfaces on each cylinder block at the rate of one completed block per minute



Bearing ways for this machine are flame-hardened cast-iron ways. The porosity of the cast iron is beneficial in retaining the oil film while the ways are given a skin surface treatment to improve wearing qualities. One of the difficulties of the hardened steel ways formerly used was the bowing action during hardening. Straightening of the hardened way and grinding to get a flat surface, without cracks, is much less difficult with the cast iron than with the steel way.

An innovation in piston-rod design is used on these machines. The piston rod, which is anchored at each end of the machine, is actually in two parts, each part carrying, in effect, one-half of a piston. From hot to cold machine there is quite a change in the length of this 37½-foot long bed, consequently it is necessary to provide some freedom for the piston rod, otherwise it would give a tierod effect which would disturb the alignment of the machine.

Source of hydraulic power consists of five constant-displacement vane type pumps, each powered by a 30-hp, 1200-rpm motor. The reason for going to multiple pumps on this machine is twofold: (a) Each pump is the largest standard commercial vane-type pump manufactured and, (b) in case of failure of a pump or motor it is easy to block this unit out of the system so that the equipment can be run at 80 per cent speed until the faulty unit has been repaired or replaced.

In the center of the bed is the hydraulic valve unit, mounted in this location in order to provide the shortest hydraulic line from the pump to the piston, where the hydraulic pressure is transformed into motion. About 300 gallons of oil per minute pass through this valve body, which has been designed with proper size valves to give a minimum wire-drawing effect.

A lubricating pump delivers oil under pressure to a manifold, which is in turn connected to three cartridge type filters. A pressure switch, in the line carrying the filtered oil to the bearing ways and other points to be pressure lubricated, is set at approximately 15 psi, and insures that clean oil under this pressure is had at all times.

Driven by the same motor as the lubrication pump is a constant-displacement vane type pump which develops the hydraulic pressure for controlling the operating cycle. This pilot pump also delivers oil to a pressure switch which maintains proper oil pressure at all times. The pilot circuit is actuated by trip dogs on both ram and fixture cradle movement and, thus energized, shifts the ram-direction valve and fixture-indexing valves. Hydraulic interlocks are provided in such a manner that it is impossible to index either fixture in or out of cut unless the machine ram is in an extreme end position, and is stationary. Conversely, the ram cannot be engaged during indexing.

Power for indexing the fixtures is obtained from a double pump, the smaller of which maintains pressure at all times. When indexing takes place the larger pump automatically cuts into the system, providing the necessary volume to index the rather large fixtures used in this machine in a relatively short period of time. The indexing movement actuates a decelerating valve which permits rapid indexing up to the point of completion, at which time the hydraulic supply is throttled. In this manner rapid indexing is obtained with a smooth stop.

This type of machine produces cylinder blocks at the rate of one completed block through both operations each minute, *Fig.* 4. In these two operations five surfaces are broached. In the first operation the pan rail and half-bore are broached. In the second operation the top, push-rod surface, and distributor pad are broached. A satin-looking finish as well as close tolerances and a high degree of flatness is obtained in high production.

Electronic Measurement in Design

By P. E. Nokes and E. G. Carr

United Shoe Machinery Corp., Research Div.
Beverly, Mass.

THE design engineer has long been aware, within a reasonable degree of precision, of the properties of the various materials he is called upon to use. He has largely failed, however, to achieve a comparable knowledge of the loads, accelerations, velocities, or hydraulic pressures in mechanical systems during actual operation. This failure can be attributed to lack of a basic system capable of following mechanical phenomena at customary working speeds. Much ingenuity has been expended in an effort to design mechanical recording systems for this purpose. The usual end result, unfortunately, has been a mechanism

which was complex, expensive, subject to error due to inertia, friction and the like and, worst of all, a single-purpose instrument.

During the past few years several electrical methods of measurement have come into prominence in the strain-analysis field. These are all characterized by, first, a fairly simple and inexpensive strain or movement-sensitive device; second, a specialized amplifier of considerable complexity; and third, a recording device. The real virtue of these systems lies in the fact that the complex and expensive amplification and recording system is standard from job to job. Only the least expensive and complicated part need be modified to suit the conditions peculiar to the individual project.

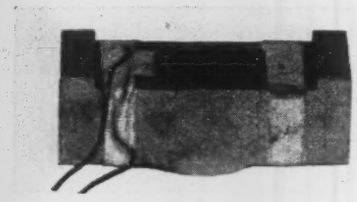


Fig. 5 — Pickup unit designed for measuring loads of several thousand pounds between a pair of flat surfaces

A variety of considerations govern the choice of apparatus for electric gaging, and these considerations have been amply covered in detail by other writers. In general, what is required is some form of Wheatstone bridge, the permanent and adjustable half of which is contained within the apparatus itself. The remaining half of the bridge, consisting of either two active strain gages or one active gage and a dummy is, of course, located on (or adjacent to) the part to be tested. It would be possible to supply this bridge from a d-c source, as far as the gage system is concerned, and this source would have the property of covering any desired frequency range. However, due to amplifier considerations, it is customary to supply the bridge from a source (usually an electronic oscillator) having a frequency between 1000 and 5000 cycles per second. Means are provided, at the output end of the amplifier, for removing this frequency from the record. The bridge and its components must be of proper design and construction, since the maximum variations to be measured are only of the order of magnitude of ½ to ¾ of 1 per cent.

Since the output of the bridge is small, the bridge is followed by an amplifier, which increases the bridge output sufficiently for recording or other purposes. Little need be said concerning this component of the system except that, again, it should be of the best quality and properly designed for the purpose. The usual general-purpose speech amplifier will not be adequate.

The amplifier system is followed by some form of indicating or recording device. For general work, static or dynamic, a multi-element bifilar oscillograph will be found most useful.

To illustrate the type of apparatus which it may be necessary to devise on the spot to cover a particular job, *Fig.* 5 shows a device used to determine loading between two flat surfaces. It will be recognized as a simple beam, supported at both ends and loaded in the center. It was designed for loads of several thousand pounds and, as shown, carried a resistance-wire strain gage for measuring purposes. Calibration was obtained with a compression testing machine of proper capacity. It is realized that various exceptions can be taken to this device by the person interested in high precision. However, it enabled its user to obtain the data with quite sufficient accuracy for the problem on hand. Further, these data were obtainable in no other way.

An interesting attempt was made to determine the loads existing at certain points on the human foot due to the wearing of shoes. It consists of a rectangular steel plate, about 0.05-inch thick, to which is cemented another steel plate having its end formed into a bow. The act of applying pressure flattens the bow, which has a small wire strain gage cemented to it, producing the actual measuring signal. In use, the entire device is coated with rubber and attached to the foot by adhesive tape.

In *Fig.* 6 is shown an interesting device, which is applied in the manner of a hand tachometer. A cardioid cam bends a light cantilever beam in such a fashion as to produce a final record which is linear with respect to the rotation of the driving shaft. It, therefore, not only counts revolutions of the driving shaft, but also indicates the details of each revolution. From the curves obtained, rotational velocity and acceleration can be readily computed.

A most versatile method of recording motions of parts, particularly where such movements cover several inches, consists of a piece of spring stock (0.015 to 0.050-inch thick) equipped with wire strain gages. One end is clamped in any convenient fashion to a stationary part of the machine. The free end is allowed to spring against, and move with, the part under test, thus producing the desired record. It might be thought that this device would produce a signal departing somewhat from linearity. It does. But under proper conditions, the departure is not great and numerous instances have shown that, in spite of this fact, the device is extremely useful. Calibration may be obtained with anything from a scale to a micrometer, depending on circumstances.

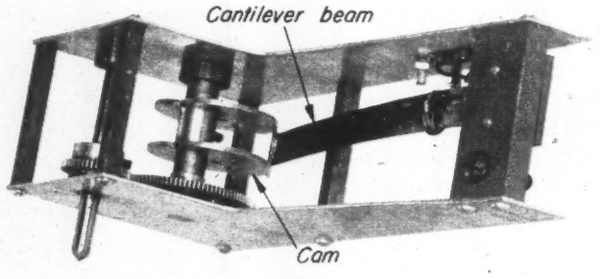


Fig. 6—Strain gages on beam deflected by rotating cam provide indications of shaft speed and acceleration

The foregoing, as well as further examples in the original paper, show the design engineer possible uses for apparatus of a general and versatile nature which he may have considered only in connection with actual stress analysis work. The apparatus is capable of considerable precision in the hands of experienced personnel, but also may be extremely useful to the design engineer who can be assisted materially by data of not too great precision. He need not be an expert to obtain such results.

Kinematics of Cam and Follower

By Allan H. Candee
Gleason Works
Rochester, N. Y.

HOW the general principles of geometry and kinematics can be applied to the design of a rotating disk cam with flat follower having straight-line motion is demonstrated in the original paper on which this abstract is based. The graphical method is not limited to determining a cam profile as the envelope of the follower, but also can be used to determine points of contact and centers of curvature so as to avoid cusps. Further, dimensions of the cam can be obtained to any desired degree of accuracy by calculations based on the geometrical constructions. The paper also shows that the methods of geometry and kinematics are practical because they are easy for a designer or draftsman to understand and use, and they lead to knowledge not likely to be obtained in other ways.

The cam is assumed to rotate at constant angular velocity and the motion of the follower is specified. The problem then is to determine the shape of the cam. Five cases of follower motion are considered, namely: 1. Zero velocity (dwell); 2.Constant velocity; 3.Constant acceleration; 4.Simple harmonic motion with one cycle per revolution of cam; and 5.Simple harmonic motion with two cycles per revolution of cam. These are all motions that might be adopted by a designer because of ease of specification or description. In each of the five cases the motion has a simple mathematical description, and it is found that the related curves can be directly described and identified. It should not be expected, however, that such curves will always turn out to be commonly known forms. When the follower motions are of more complex descriptions the related curves are correspondingly more complex.

In the original paper it is shown in detail what can be accomplished by the method of geometrical kinematics in two of the five cases. The general facts for all five cases are collected in the accompanying table.

A cam may be required to produce different kinds of motion during portions of a revolution. The different curves forming the cam contour can be properly joined by laying them out to have a common normal where one curve connects with another. Sometimes a cam can be generated mechanically; in other cases, points on the cam profile may be accurately calculated and a closely spaced series of cuts taken by a milling cutter. When mathematical exactness is not required in the motion, it may be practical to use an arc of the circle of curvature for a portion of the profile.

Kinematic Data and Geometrical Results

Motion of follower	Zero velocity	Constant velocity	Constant acceleration	Simple harmonic motion	
				One cycle	Two cycles
Co-ordinate displacements of center of curvature in direction of: Tangent Normal	Zero Zero	Constant Constant	Increasing Constant	Harmonic displacement	Harmonic displacement
Position of normal	Fixed, at center	Fixed, offset	Changing at constant velocity	Harmonic displacement	Harmonic displacement
Center of curvature relative to frame	Stationary, at center	Stationary, offset	Moving on offset line	Displaced around circle	Displaced around ellipse
Evolute of cam profile	Point	Circle	Involute of circle	Point	Hypocycloid of four cusps
Cam profile	Circle	Involute of circle	Involute of involute of circle	Circle	Involute of hypocycloid
Instant center	At center of rotation	Fixed	Moving along line of centers at constant velocity	Harmonic displacement	Harmonic displacement
Centrode of follower	Straight line, on center	Straight line, offset	Parabola	Circle	Ellipse
Centrode of cam	Point, at center	Circle	Spiral of Archimedes	Circle	Four-looped hypocycloid

Ball Bearing Ratings

By Thomas Barish
Washington, D. C.

PRESENT ball and roller bearing ratings are based on a limited number of tests, in order to yield results in a reasonable time. These tests can cover only a few sizes and a relatively narrow range of loads and speeds. Extrapolation to other sizes and loads has been done by utilizing the theories of Hertz and Stribeck. The Hertz theory gives the dimensions of the contact ellipse, *a* and *b*, *Fig.* 7, and the unit pressures on the contact surface. Maximum pressure at the center, Q_o, frequently called the Hertz pressure, rises to very large figures—up to 700,000 psi under regularly employed static loading—but they cannot be compared with strength tests on the material because side support around the point of maximum loading, *A*, permits higher stresses than the strength of the material under simple stressing would indicate.

The point of true maximum stress and ultimate failure is below the surface, and formulas for what happens in this area were developed and published by two independent authorities in 1929 and 1930, with particular reference to railroad rails. In the original paper the author uses these new data to attempt a theoretical de-

rivation of ball-bearing ratings from the fatigue strength of the material. The final modified capacity equation is

$$Q = \text{(constant)}\ \phi d^{1.7}\ \sqrt[3]{B^2/HR}$$

where ϕ is the coefficient of osculation, a nondimensional figure representing the intimacy of contact based on the ratios of the various radii, B is the number of balls, d is the ball diameter in inches, H is the ratio of outer race diameter to pitch diameter, R is the revolutions per minute, and Q is the radial load in pounds. This new formula differs from previous rating formulas in the following respects:

1. Effect of fatigue has been neglected. The previous rating formula (Capacity $= Knd^2/5$) holds only for static conditions. It should be retained as a completely independent system for static loading.

2. Fatigue effects make the capacity vary with $\sqrt[3]{B^2}$ and not with B, hence a bearing with 12 balls is not 50 per cent better than one with 8 balls, but only 31 per cent better.

3. In the past it has been assumed that, for example, a ½-inch ball in a 200 (light) series bearing has the same value as a ½-inch ball in a 400 (heavy) series bearing. The new formula shows two opposing effects which do not always balance out. The larger race diameter in the first case gives a wider contact area; specifically, the coefficient of osculation, ϕ, would be 14.6 as against 12.4 and the capacity should be in proportion. This is offset by the more frequent stressings in the 200 series bearing, which would have more balls, and is represented by the factor $1/\sqrt[3]{H}$ in the equation. These two effects do not exactly compensate. In other words $\phi/\sqrt[3]{H}$ is not constant, and replacing it by a constant is not justified since it only saves some arithmetic in first setting up the ratings. One of the large bearing companies has maintained that such a difference does exist between the 200 and 300 series, as evidenced by tests alone.

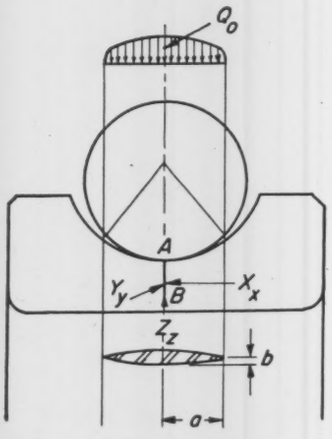


Fig. 7 — Contact area and pressure between ball and inner race, which can be calculated by Hertz theory

4. Under thrust loads, the maximum stress is repeated on each point of the inner ring for every ball contact, hence the thrust capacity would be considerably less than under static conditions, when stated as a percentage of the radial capacity. This applies to both radial ball bearings and angular-contact types. Three factors are involved: (a) Greater frequency of loading, (b) occurrence of maximum load every time, and (c) improvement in the intimacy of contact when riding up the side of the inner race groove. Calculations from the formula applied to a typical set of bearings indicate a larger allowable static thrust and a smaller ratio for thrust while rotating. The amount of change depends upon how much previous ratings had been modified to suit test results.

Present-day ball and roller bearings show a very large variation in life within any one group of apparently exactly similar bearings. Ratios up to thirty to one are quite common for maximum to minimum life, and five to one is considered fairly standard for average to minimum life. Such a dispersion is quite disconcerting when trying to select bearings or use them.

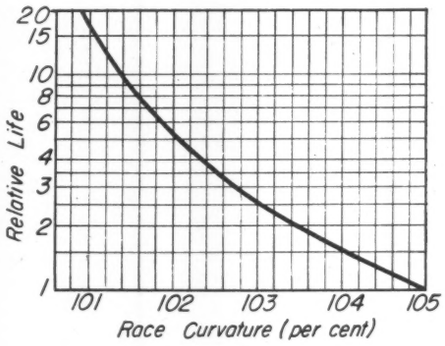


Fig. 8—Relative life of a typical ball bearing as a function of race curvature, calculated by new formula

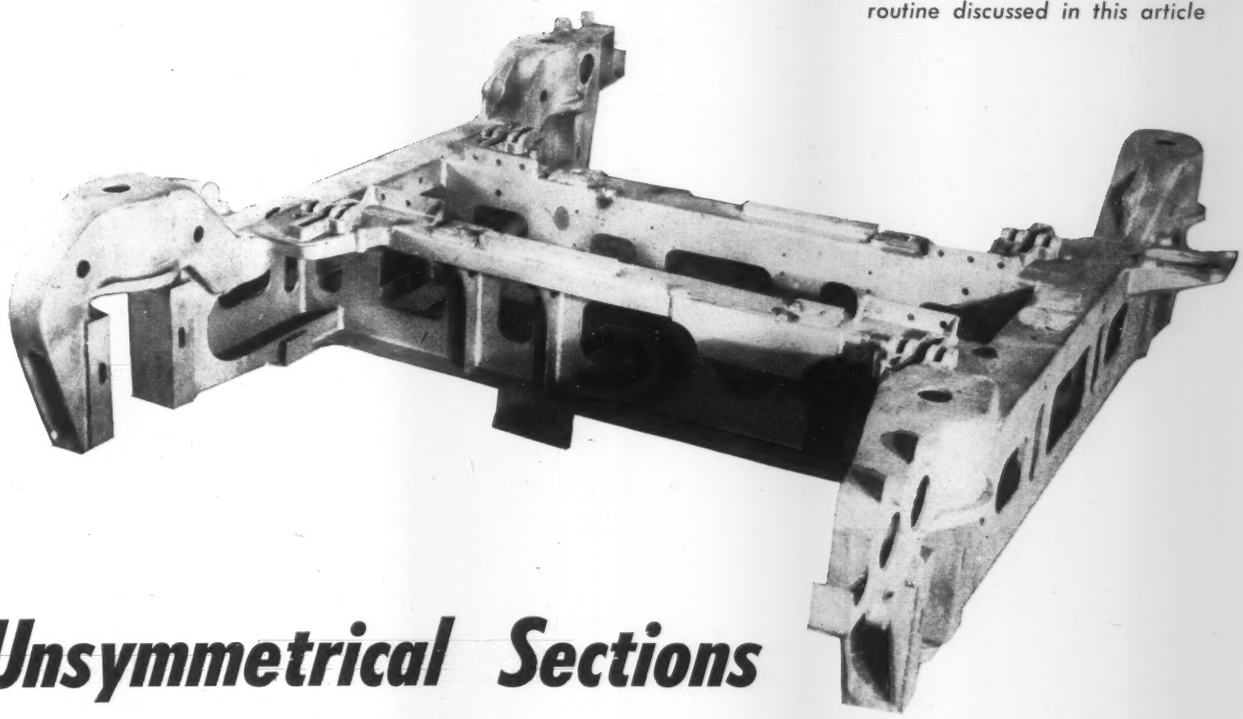
To further investigate this subject, calculations were made by the new equation for each controlling variable to find the life change produced by the expected tolerance range according to present-day practice at its worst. Steel hardness, varying from 65 to 62 rockwell C, was converted to strength by the standard hardness conversion tables. The ratio of resulting life variation was 1.58 to 1, from which it is concluded that steel variations produce only a small part of the total life variation.

Effect of Race Curvature Tolerance

Other factors, except the tolerance on race curvature, also are negligible. Race curvature variation from 101.5 to 103.5 per cent of ball radius caused a ratio of life variation 5 to 1. At first sight such a large change in life does not seem reasonable, but such a small part of the total ball surface is used at any one time (about one-half of one per cent) that a small improvement in race curvature can produce considerable percentage increases in utilization. *Fig.* 8 shows the change to be expected over the whole range, as calculated by the new equation. It is concluded that bearing life could be made far more consistent by a radical reduction in race curvature tolerances. Particularly, it should be possible to eliminate much of the "infant mortality" in the life distribution curves.

Test runs at Marlin Rockwell Corp. to check this conclusion showed marked reduction in life dispersion ratio for one small lot, but then did not repeat. Evidently there are still other variables producing life fluctuation, probably some connected with surface conditions. This should be a fruitful field for further research.

Fig. 1—Strength and stiffness calculations for machine structures, such as this railroad truck, are aided by the adoption of the systematic routine discussed in this article



Unsymmetrical Sections

Simple procedure facilitates calculation of section properties such as center of gravity and moment of inertia about any axis

By A. B. Cox
United Engineering & Foundry Co.
Pittsburgh

METHODS presented in this article for finding the moment of inertia of an unsymmetrical section are simple and generally applicable to sections of all types, such as unequal leg angles and built-up sections, whether structural or cast and whether unsymmetrical or symmetrical, *Fig.* 1. The underlying principles have long been known, but convenient details for applying these principles to practical design are not so well known. These details should interest many designers who do not have time to work them out themselves for their permanent records and use.

A car sill (half center) section, *Fig.* 2, illustrates all the points that need to be covered in the explanation. In the calculations, fillets and rounded corners are ignored—a good enough approximation for all practical purposes.

MOMENT OF INERTIA: Any neutral axis of a section passes through the center of gravity (marked *CG* at *O* in *Fig.* 2). The position of the center of gravity is found as a byproduct of the general method of finding the moment of inertia. In this particular case, the center of gravity just happens to come almost exactly on a border line of the section; it might fall inside or outside of a section, depending on the particular shape.

The entire section is first divided up into any convenient number of simple subsections (in *Fig.* 2, only three) with their centers of gravity at A_1, A_2, and A_3. To find I_y any convenient vertical axis is chosen, such as *n-n* in *Fig.* 2. If this axis is chosen just at the border of the section (theoretically outside the section), plus and minus signs can be ignored, and there is less danger of making any serious error.

It is convenient to tabulate the calculation, as in TABLE I; this is all the more desirable when the number of subsections is large, as in *Fig.* 3. All measurements are in inches. The distance x of the center of gravity of each subsection from the axis *n-n* must be scaled or calculated. The number of each subsection is listed in the first column of the table; w and d indicate the width and depth of each subsection, and A is the area of each. I_g denotes the moment of inertia of each subsection about its own center of gravity. This value can be calculated for rectangular sections by the formula $I_g = wd^3/12$ or still more easily taken from a table of moments of inertia for rectangles of various heights and unit width.

At first glance these values of I_g are comparatively so small that is seems possible to neglect them, but this is not

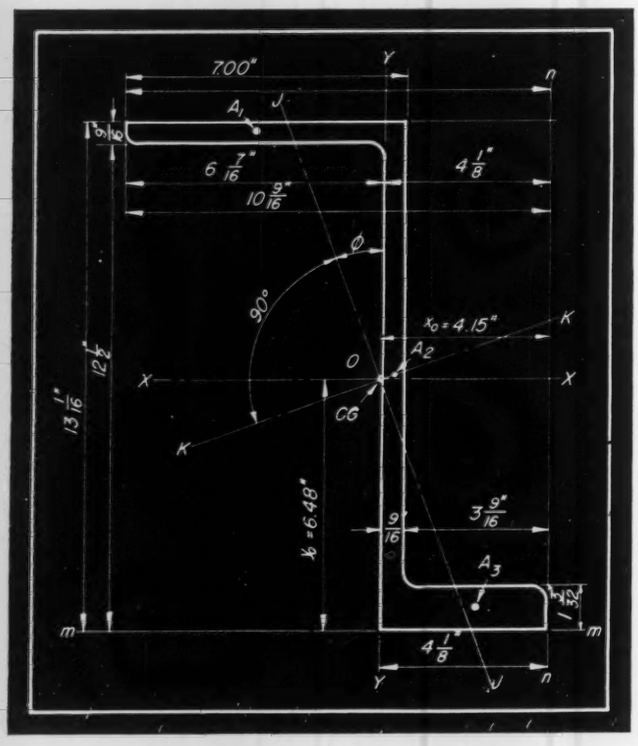


Fig. 2—Car sill section, illustrating method of determining section properties. Moment of inertia is minimum and maximum, respectively, about axes J-J and K-K

so. In TABLE I the sum of all the I_g values, 16.88, is a small fraction of the sum of all the Ax^2 values, which is 316.1. But they are not a small fraction of the final moment of inertia I_y, which is 77.0, and if the values of I_g were neglected, this moment of inertia would be in error by 16.88/77.0 or 22.0 per cent.

Distance x_o of the *CG* from axis *n-n* is found by dividing the sum of all the Ax values by the sum of the A values, that is, by the total area of the section. In this particular case the *CG* is so close to the boundary of the web of the sill that it appears to coincide with it.

Moment of inertia of the section about the neutral axis *Y-Y* through the center of gravity at *O* is equal to the sum of all the Ax^2 values minus x_o^2A, or $I_y = \Sigma(Ax^2) - x_o^2\Sigma(A) = 77$ inches^4.

There are two values of the section modulus Z, one for the long flange and one for the short flange. This is because the distances from the center of gravity to the outermost fibers of these flanges are not equal. The smaller value, Z = 77.0/6.44 = 11.95 inches^3, for the longer flange should, of course, be used, because yielding of the material will take place on the long flange first.

By assuming a second convenient horizontal axis *m-m* perpendicular to axis *n-n*, the position of the center of gravity along *Y-Y* can be located at the intersection of *Y-Y* and *X-X*; then the moment of inertia I_x, about axis *X-X*, can be found using TABLE II, which is exactly similar to TABLE I. In this case, because the distances from the center of gravity to the outermost fibers of the two flanges are approximately equal, the section moduli for the two flanges are substantially equal about axis *X-X*.

Illustrating the application of the foregoing principles to a more complex structure, *Fig.* 3 shows details of a half section through a forging press base, the calculations being given in TABLE III. The neutral axis *X-X* is located 21.8 inches above axis *M-M*, and 14.45 inches below the top of the base. In general, when the neutral axis is not substantially halfway between the extreme top and bottom fibers of the section, this is an indication of poor design. This section would have just as much strength with less metal if the 36.25-inch depth were decreased a little and enough metal added to subsection 3 to bring the neutral axis down to the halfway position between the top and bottom of the casting.

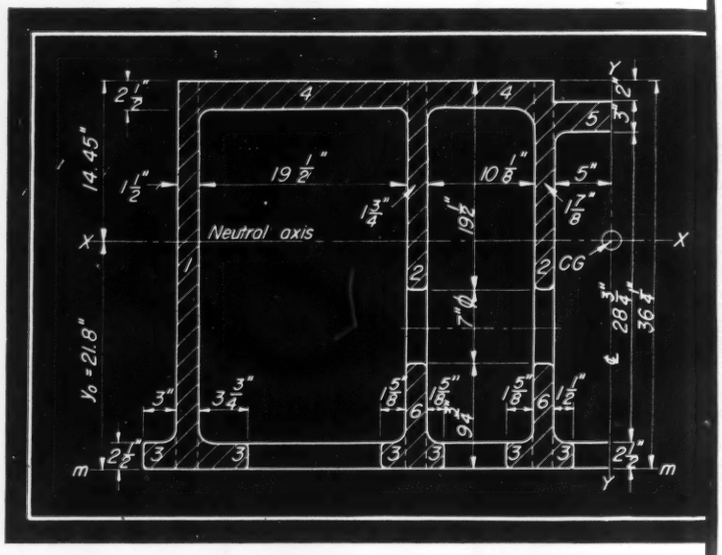


Fig. 3—Half section through forging press base. Design could be improved by redistribution of metal so as to bring the neutral axis nearer the mid-depth

LEAST STIFFNESS: It is sometimes desirable to know the position of the axis about which the stiffness of a beam will be a minimum or a maximum. For instance, all rolled

TABLE I Moment of Inertia About Y-Axis

Subsection	w × d = A	x	Ax	Ax^2	w × d^3/12 = I_g
1	0.56 × 6.44 = 3.62	7.34	26.58	195.3	0.56 × 22.8 = 12.83
2	13.06 × 0.56 = 7.35	3.84	28.23	108.4	13.06 × 0.01 = 0.13
3	1.09 × 3.56 = 3.90	1.78	6.94	12.4	1.094 × 3.6 = 3.92
	14.87		61.75	316.1	16.88

$x_o = 61.75/14.87 = 4.15$ inches
$I_y = I_n - x_o^2A = 333.0 - 4.15^2 \times 14.87 = 77.0$ in.^{4}
$I_n = 316.1 + 16.9 = 333.0$ in.^{4}

TABLE II Moment of Inertia About X-Axis

Subsection	w × d = A	y	Ay	Ay²	w × d³/12 = I_g
1	6.44 × 0.56 = 3.62	12.78	46.25	592.0	6.44 × 0.01 = 0.06
2	0.56 × 13.06 = 7.35	6.53	48.10	314.2	0.56 × 185.8 = 104.00
3	3.56 × 1.09 = 3.90	0.55	2.15	1.2	3.56 × 0.118 = 0.42
	14.87		96.50	907.4	104.48

$y_o = 96.50/14.87 = 6.48$ inches $\qquad I_m = 907.4 + 104.5 = 1011.9$

$I_x = I_m - Ay_o^2 = 1011.9 - 6.48^2 \times 14.87 = 387.9$ in.⁴

steel shapes are likely to be too warped for use immediately after cooling in the steel mill. Such structural shapes are usually run through a "leveler" or straightening machine which makes the beams commercially straight. The straightener will consume the least horsepower if the beam to be straightened is run through the machine with its section tilted at the proper angle so that its resistance to being straightened is a minimum, that is, in the position in which its moment of inertia is least. Likewise in design the strength of long members loaded in compression is determined by the least stiffness, regardless of the orientation of the section, hence knowledge of this value is essential.

The position of the axis of minimum moment of inertia could be found by trial and error, but this would be a laborious process. It is much easier to find the axis of minimum moment of inertia (*J-J*, in *Fig.* 1) by the formula,

$$\tan 2\phi = 2 I_{xy}/(I_x - I_y) \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

where ϕ is the angle shown in *Fig.* 2, and I_{xy} is what is called the "product of inertia."

Product of inertia has no physical significance, but is a convenient expression to use in finding the moment of inertia of a section about any neutral axis inclined at any angle. For rectangular subsections, such as in *Fig.* 2,

$$I_{xy} = \int_{x_1}^{x_2} \int_{y_1}^{y_2} x\, y\, dx\, dy \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

This can be integrated and the limits substituted, giving

$$I_{xy} = \tfrac{1}{2}(x_2^2 - x_1^2) \times \tfrac{1}{2}(y_2^2 - y_1^2) \quad \ldots\ldots\ldots (3)$$

where x_1 and x_2, y_1 and y_2 are the distances in inches from the center of gravity of the total section to the near and far side, respectively, of each subsection as listed in TABLE IV.

Product of inertia of any total section is the sum of all the products of inertia of the component subsections. The sum of all the I_{xy} values for the component subsections in *Fig.* 2 is $I_{xy} = 128.7$ inches⁴. Since squaring

Fig. 4--Polar diagram for moment of inertia of car sill section. Ratio of maximum to minimum is 14:4

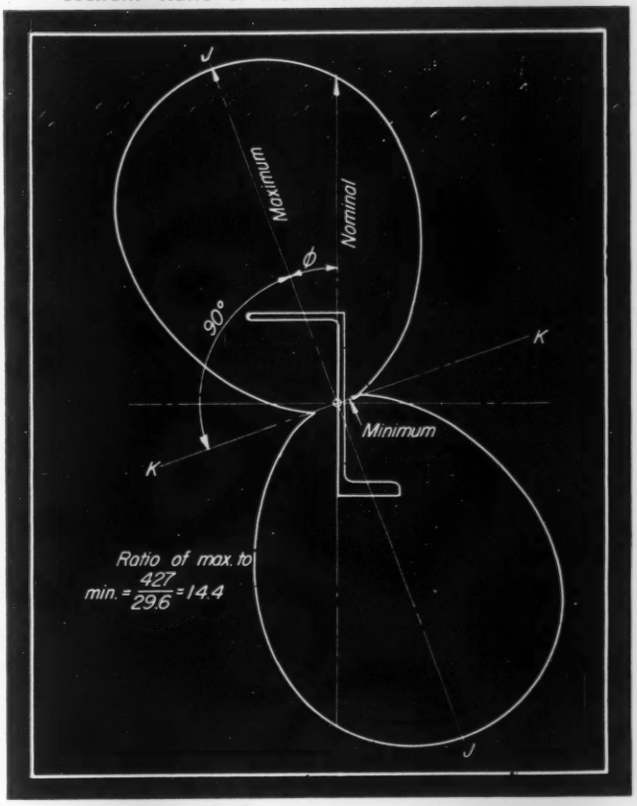


TABLE III Moment of Inertia of Forging Press Base

Subsection	w × d = A	y	Ay	Ay²		I_g
1	1.5 × 36.25 = 54.4	18.125	988	17,900	1.5 × 8 × 496.2	= 5,990
2	3.625 × 19.5 = 70.7	26.5	1873	49,700	3.625 × 617.9	= 2,240
3	13.125 × 2.5 = 32.8	1.25	41	51	13.125 × 1.302	= 17
4	29.625 × 2.5 = 74.	35.	2590	91,000	29.625 × 1.302	= 39
5	5 × 3 = 15.	32.75	492	16,000	5 × 2.25	= 11
6	3.625 × 9.75 = 35.3	48.75	172	840	3.625 × 77	= 279
	282.2		6156	175,491		8,576

$y_o = 6156/282.2 = 21.8$ inches $\qquad I_m/2 = 175{,}491 + 8576 = 184{,}067$

$I_x = 2\,[184{,}067 - 21.8^2 \times 282.2] = 100{,}134$ in.⁴

TABLE IV Computation of Product of Inertia

Subsection	x_2	x_2^2	x_1	x_1^2	y_2	y_2^2	y_1	y_1^2	$\triangle I_{xy}$
1	−6.44	41.5	0	0	6.58	43.3	6.02	36.2	73.70
2	0.56	0.32	0	0	6.58	43.3	−6.48	42.0	0.10
3	4.15	17.2	0.56	0.32	−6.48	42.0	−5.39	29.0	54.90
								I_{xy} =	128.7 in.^{4}

the minus quantities results in a plus product, the signs of the x and y measurements here can be disregarded.

Substituting the values of I_x, I_y, and I_{xy} in Equation 1, $\tan 2\phi = (2 \times 128.7)/(387.9 - 77.0) = 0.827$. A table of tangents shows $2\phi = 39° 32'$ from which $\phi = 19° 46'$. This angle ϕ locates the position of the axis, *J-J*, of minimum stiffness of the section shown in *Fig.* 2. The position of the axis of maximum stiffness, *K-K*, is perpendicular to axis *J-J*.

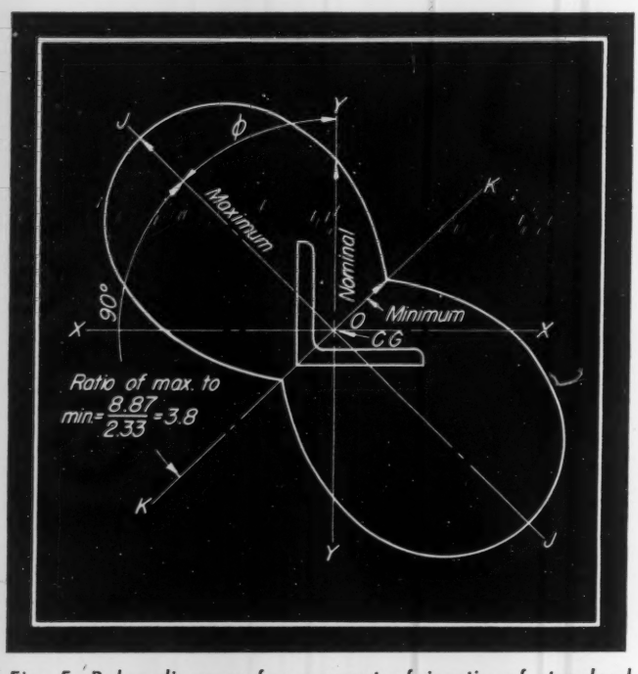


Fig. 5—Polar diagram for moment of inertia of standard 4 x 5 x ½ angle. Ratio of maximum to minimum is 3:8

MOMENT OF INERTIA ABOUT ANY AXIS: The moment of inertia about a neutral axis inclined at any angle ϕ through the center of gravity can now be found by the formula

$$I = I_x \cos^2\phi + I_y \sin^2\phi - I_{xy} \sin 2\phi \quad \ldots\ldots\ldots (4)$$

or by the formula

$$I = \tfrac{1}{2}(I_x + I_y) + \tfrac{1}{2}(I_x - I_y)\cos 2\phi - I_{xy}\sin 2\phi \ldots (5)$$

Either of these formulas can be used to plot a polar diagram of the moment of inertia of a section, as shown in *Fig.* 4, for the car sill of *Fig.* 2, and in *Fig.* 5, for a standard angle. The ratio of maximum to minimum stiffness is rather surprising—more than 14 to 1 for the car sill, and almost 4 to 1 for the angle. The ratio of maximum to minimum section modulus is only about half these figures, that is, about 7 to 1 and 2.3 to 1 for the car sill and angle respectively.

Methods presented here, in a practical sense, are general and applicable to all usual sections. The method of finding the simple moment of inertia of a nonstandard section, as is done in TABLES I and II, is most frequently used. It is applicable to any built-up section, whether the component subsections are cast or rolled shapes, and whether the total section is of the "box" type, *Fig.* 3, or of the open type, *Fig.* 2.

It is usually more convenient to allow for drilled or cored holes in the section by calculating the total section and then using minus signs in front of the areas of the subsections represented by the holes. For inclined axes, more complicated relations can be used to obtain simpler plots of inertia, such as the Ellipse of Inertia, but these are not as quickly and easily made, or as informative to the engineer as the plots shown in *Figs.* 4 and 5.

REFERENCE

Strength of Materials—James E. Boyd, McGraw-Hill Book Co., New York, 1935, chapter on Moment of Inertia.

Improving Wire Rope Life

EFFECT of rope diameter on the service life of wire rope was dramatically illustrated by the performance of two power shovels of equal capacity, working side by side on the same job and both operated by skilled shovel runners. The only difference between the two outfits was that one was equipped with 1-inch diameter rope while the other had 1⅛-inch rope, the sheave grooves having been regrooved to accommodate the larger rope. Sheave diameters were identical, and the ropes were identical in construction—6 by 19 preformed regular lay, improved plow steel. Service records showed that in the life of the rope the machine with the larger rope moved a total of 257,967 tons of material while the other moved only 112,184 tons.

This comparison was cited by Mr. E. Styris, purchasing agent for the Isbell Construction Co., Reno, Nev., to support his contention that manufacturers of heavy equipment using wire rope are making the sheave and drum grooves too small, necessitating the use of small ropes.

It is suggested that machine designers may still be working to empirical rules suitable for the old-style non-preformed wire rope, and failing to take into consideration the extreme flexibility of preformed wire rope and its improved resistance to fatigue in bending, which permits the use of smaller sheave or drum sizes in relation to the rope size. Inasmuch as more than half of all the wire rope used in the United States is preformed, there is no reason why relatively larger ropes cannot be provided for, with the attendant result of greatly increased life as the foregoing experience shows.

TRADEMARKS for Machines

How engineers can assist in selecting effective trademarks, and how new law improves their protection

By George V. Woodling

IN PROTECTING machines against competition, trademarks play a prominent part, *Fig.* 1, in many instances more important than patents. Too often insufficient consideration is given to the importance of trademarks before they are actually adopted, with the result that their weaknesses may be discovered only after they have been used for a number of years in the trade, when a legal attempt has to be made to stop their use by competitors.

Policy in many companies is to seek the aid of their engineers in selecting and creating new trademarks; machine designers with their intimate knowledge of the equipment which they themselves have designed are particularly well qualified to assist in this matter. Inasmuch as there are important legal aspects also to be considered, it is the purpose of this article to bring engineers up to date on the subject and, in particular, to discuss certain phases of the new federal trademark law which becomes effective July 5, 1947. One of the prime purposes of this new act is to gear the trademark laws to the needs of our modern industry inasmuch as laws, like obsolete machinery, need to be brought up to date for efficient operation.

Before discussing the new law, it may be well to provide the reader with a background for the selection of good legal trademarks. Later it will be

Fig. 1—Right—Under new law descriptive words, or geographical names such as Cincinnati, after accepted use may be given the same legal force as registered technical trade marks

Ser. No. 315,788. CHRYSLER CORPORATION, Highland Park, Mich. Filed June 13, 1931.

FLOATING POWER

For Vehicle Engine Mountings. Claims use since June 3, 1931.

Fig. 2 — Left — A suggestive trade mark, such as "Floating Power", constitutes one of the best types inasmuch as it is not descriptive of the product

shown how the chosen trademark is accorded protection under the new law.

It is a common desire to adopt a trademark which tends to describe the product. These are called discriptive or nontechnical marks, as opposed to arbitrary or technical marks. From a legal point of view descriptive marks are not accorded the same protection as technical trademarks, because the courts construe descriptive marks so narrowly that quite similar trademarks may be used by competitors with impunity, even for the same class of goods. Descriptive marks are characterized by the fact that they describe the function of the machine or the result produced by the machine.

On the theory that no one should be able to withdraw from the English language words which others use for describing the character, kind or quality of their product, the courts are quite strict about permitting one to monopolize a descriptive word. Realizing that descriptive marks possess potent advertising power but lack legal qualifications, the engineer is in a vital position to exercise his keen sense of balance and choose a mark which approaches the area of descriptiveness but still is a good legal technical mark. The area which is just in advance of descriptiveness is called the "area of suggestiveness." Trademarks which fall within the area of suggestiveness constitute one of the best types. Such a mark, for example, is that of "Floating Power" for engine mountings, *Fig.* 2. In the decision that held that Floating Power was not descriptive of the goods, the court made the following distinction, which may serve as a guide for engineers in selecting proper trademarks:

> "It would seem to be clear that the term *power*, as used in appellant's trademark, is not the equivalent of the terms *engine* or *power plant*, nor is it, standing alone or in combination with the word *floating*, descriptive of either. The terms *floating engine* and *floating power plant* are descriptive of certain physical units, and those units may be assembled or disassembled. That is not true of the term *floating power* . . . . *Power* is an intangible thing, and merely combining the words *floating* and *power* does not make the combination tangible or descriptive of anything that is tangible."

From the foregoing it is to be noted that *suggestiveness* is a permissible and invaluable attribute of a technical trademark, and that suggestive marks are evolved by using abstract rather than concrete terms.

It is difficult to define a descriptive mark, but a familiar example will indicate the nature of such marks and the reason why they cannot be monopolized as valid technical marks. In the case of Kellogg Co. vs. National Biscuit Co., the Supreme Court of the United States held:

> "The plaintiff has no exclusive right to the use of the term "Shredded Wheat" as a tradename. For that is the *generic term of the article, which describes it* with a fair degree of accuracy; and it is the term by which the biscuit in pillow-shaped form is generally known to the public. Since the term is generic, the original maker of the product acquired no exclusive right to use it."

Other examples of names held to be descriptive and incapable of monopolization as technical trademarks are listed in TABLE I. The fact that words are misspelled does not keep them from being held descriptive. If the words sound descriptive, they will be held descriptive regardless of spelling. It is of interest to note that "Frigidaire" applied to electric ranges and water heaters is not descriptive, and therefore may be classed as arbitrary or technical, TABLE II.

TABLE I

Descriptive Trademarks

Trade Mark	Description
Copper Clad	Copper-clad steels
Hicycle	High-speed electric tools
Boiler Meter	Boiler steam-flow indicator and recorder
Aircraft Control	Aircraft indicating instruments
Frigicar	Mechanically cooled railroad car
Vistand	Vise stand
Floating Engine	Engine mountings
Copper Weld	Copper-covered steel wire
Steem Electric	Electric sadiron
Wire Heat	Electric heater
Multi-Breaker	Electric circuit breaker
Frigidaire	Refrigerator
Mass-Flo	Traveling conveyors
Sure Flow	Pump

Suggestive marks, with the use of imagination and fancy, will connote some abstract thought of the product. A good example is the word "Ivory" when applied to soap. It does not describe soap and an individual hearing the word in the absolute would not know that there was any connection with soap. However, when the word is actually used on soap and some imagination is exercised, there is a suggestiveness of whiteness and purity, both highly desirable qualities in soap. Other examples of names held to be suggestive and constituting good technical trademarks possessing adequate legal force are given in TABLE II.

The trademarks which are accorded the greatest amount of legal protection are words which are arbitrary and original with the adopter, such as "Kodak" for cameras. These types are coined words which in the beginning have no meaning whatsoever, but which through advertising become well known everywhere. A legal warning may be sounded at this point to the effect that a trademark should not be excessively advertised to the point where it becomes so impressed upon the minds of the public that it is regarded as the name of the product itself. When,

New Philadelphia

Fig. 3—A coined word affords the maximum amount of legal protection. The word "Ladel" is taken from the name of the town in which the equipment is made

through advertising or general use, a mark becomes descriptive of a class of goods rather than indicating a particular product, then it may lose its meaning as a technical trademark.

The coining of trademarks is a facinating endeavor. The only guide to keep in mind is that the word should be easy to pronounce, easy to spell, and easy to remember. Most frequently coined words are made up by arranging a series of letters selected from a word or phrase which is descriptively or geographically related to the business or products of the company. As an example, the La-Del Conveyor & Mfg. Co., which is located at New Philadelphia, Ohio, and manufactures coal-mine loading equipment and conveyors, evolved its name by selecting the word from Philadelphia, *Fig.* 3. The Flodar Corp. of Cleveland manufactures hydraulic tube fittings, and evolved its name from a phrase descriptive of its hydraulic development work, *Fig.* 4. The words La-Del and Flodar are good arbitrary coined words and are the type of words which qualify well under the new trademark act.

TABLE II
Suggestive Trademarks

Trade Mark	Description
Lightning	Carbon Remover
Magic Door	Photo-electrically controlled door
Rusticide	Chemical rust remover
Streamlite	Flashlight
Holeproof	Hosiery
Stabrite	Polish to preserve metal
Floating Body	Vehicle-lifting device
Frigidaire°	Electric ranges
Frigidaire°	Building-service water heaters

° Note that the word Frigidaire, when applied to refrigerators is held to be descriptive, see TABLE I.

The new act, often referred to as the Lanham act, provides for two types of registers in the Patent Office, one called the "Principal Register" for registering coined and suggestive marks and the other called the "Supplemental Register" for registering descriptive marks. Trademarks which are geographically descriptive are classified along with descriptive marks and may be registerable on the supplemental register. The act provides that, for the purpose of registration on the supplemental register, a mark may consist of any trademark symbol, label, package, configuration of goods, name, word, slogan, phrase, surname, geographical name, numeral, or device, or any combination of any of the foregoing. However, such mark must be capable of distinguishing the applicant's goods or services.

Another important provision of the new act is that it contains a "graduation clause" whereby a mark, even though it be descriptive or geographically descriptive in the early stages of its use and be registerable on the supplemental register, may be subsequently re-registered on the principal register, provided the mark has become distinctive through use in the trade.

Fig. 4—How another coined word was derived; phrase describes activities of company making hydraulic fittings

An excellent example of a descriptive mark which has become distinctive through use in the trade is the trademark "Frigidaire," for refrigerators. An example of a geographical trademark is that of "Cincinnati" for milling and grinding machines, *Fig.* 1. Under the new law, the words "Frigidaire" and "Cincinnati," when declared distinctive by the Commissioner of Patents, may be registered on the primary register and be given the same legal force and effect as if they were technical or nondescriptive trademarks. Under the existing law there was no provision whereby a mark, once declared descriptive, could ever be graduated into a technical trademark. The Commissioner of Patents may accept as prima facie evidence the fact that the mark has become distinctive, provided the mark has had substantially exclusive and continuous use for five years before the application is made for graduation to the principal register. In other words, no descriptive mark can become distinctive should someone else also claim valid use of the mark for the same class of goods, constituting a double use.

New Act Permits Concurrent Use

Double use of a mark is referred to as "concurrent use" in the new act, and provision is made for both parties making separate registrations for the mark, provided the use of the mark by each of the parties is in different localized parts of the country. Under the existing laws, concurrent registration could not be had.

Except for the registration of a mark under concurrent use, the new act gives nation-wide protection when the mark is registered on the principal register. This does not now exist when a trademark is registered in the Patent Office. For example, everything else being equal, the owner of a trademark whose actual trade is exclusively in the Eastern states cannot rightfully claim infringement of his mark by one whose trade is exclusively on the West Coast. Under the new act, registration of a trademark upon the principal register tends to make the registration operate like that of a patent, in that the trademark right is coextensive with the entire territory of the United States.

Another important provision of the new trademark act is that it changes the law with respect to the assignment of trademarks. Under the existing law, a trademark cannot be assigned by itself, in that it can be assigned only in connection with the goodwill of the business with which the mark was used. Under the new law, a manufacturer

Flow Development And Research

is given the right to divide his business either geographically or with respect to different types of products manufactured and to assign one or more of his trademarks separately to the person acquiring the limited territorial right or the limited production rights. For example, the ABC Co., manufacturing and selling machinery in the Eastern half of the United States under a certain trademark, can assign the trademark for use on the same machinery made and sold by the XYZ Co. in the Western half of the country.

When a mark has once become registered, the new act provides that the owner shall give notice that his mark is registered, by displaying with the mark as used the words "Registered in U. S. Patent Office" or "Reg. Pat. Off.", or the letter R enclosed within a circle. If the owner fails to do this, then in any suit of infringement under this act he cannot recover profits or damages unless the defendant has actually been notified of the registration.

Household Sewing Machine Passes Century Mark

RECOGNIZED as the first mass-produced household machine, the sewing machine has been a household necessity for one-hundred years. In the closing months of 1846 Elias Howe patented, produced and sold ten machines which were turned by a hand crank, the foot treadle appearing the following year. Although electrification of the sewing machine became standard about 70 years later, the basic principle of the machine remains as originally conceived by Howe.

Truly a revolutionary invention, over 100,000 models were sold within a ten-year period from the time the machine was first introduced. This fact becomes all the more remarkable when compared with merchandizing figures for more recently developed household equipment. Twelve years passed after the introduction of electric washers, for instance, before 100,000 units were sold. Eleven years passed before an equal numer of radios was sold and ten years elapsed for refrigerators.

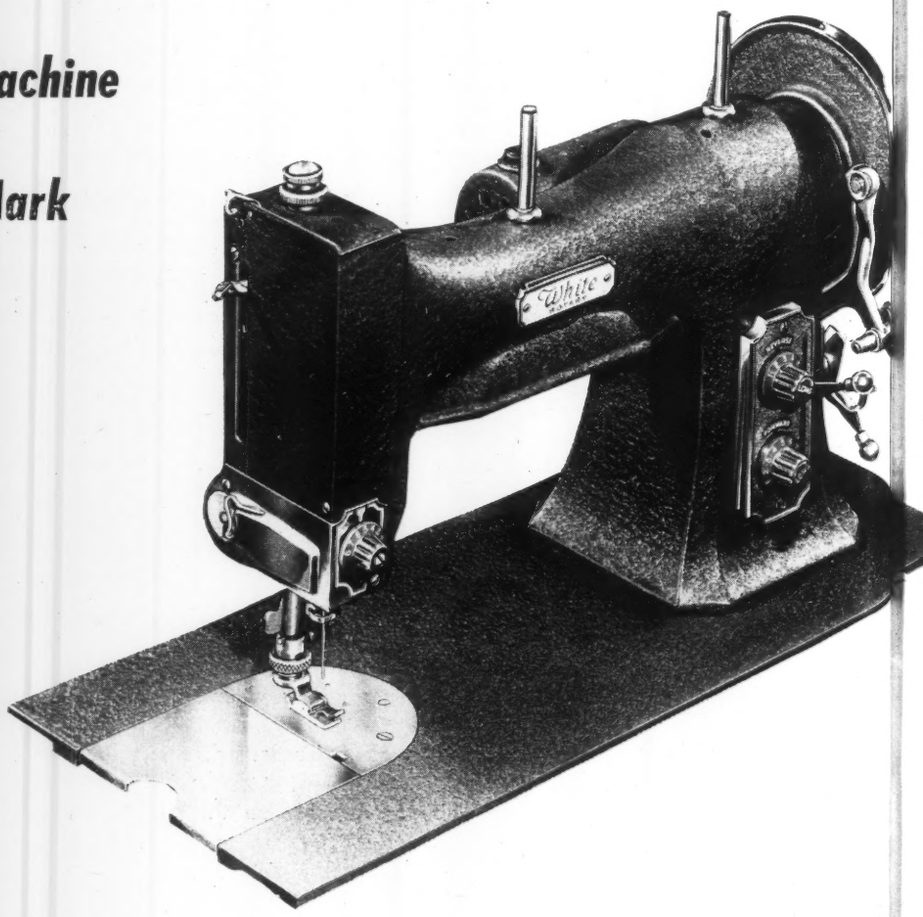


Fig. 1—Modern sewing machine head. To facilitate operation, convenient adjustments are provided for varying stitch length, forward and backward sewing, and changing thread tension

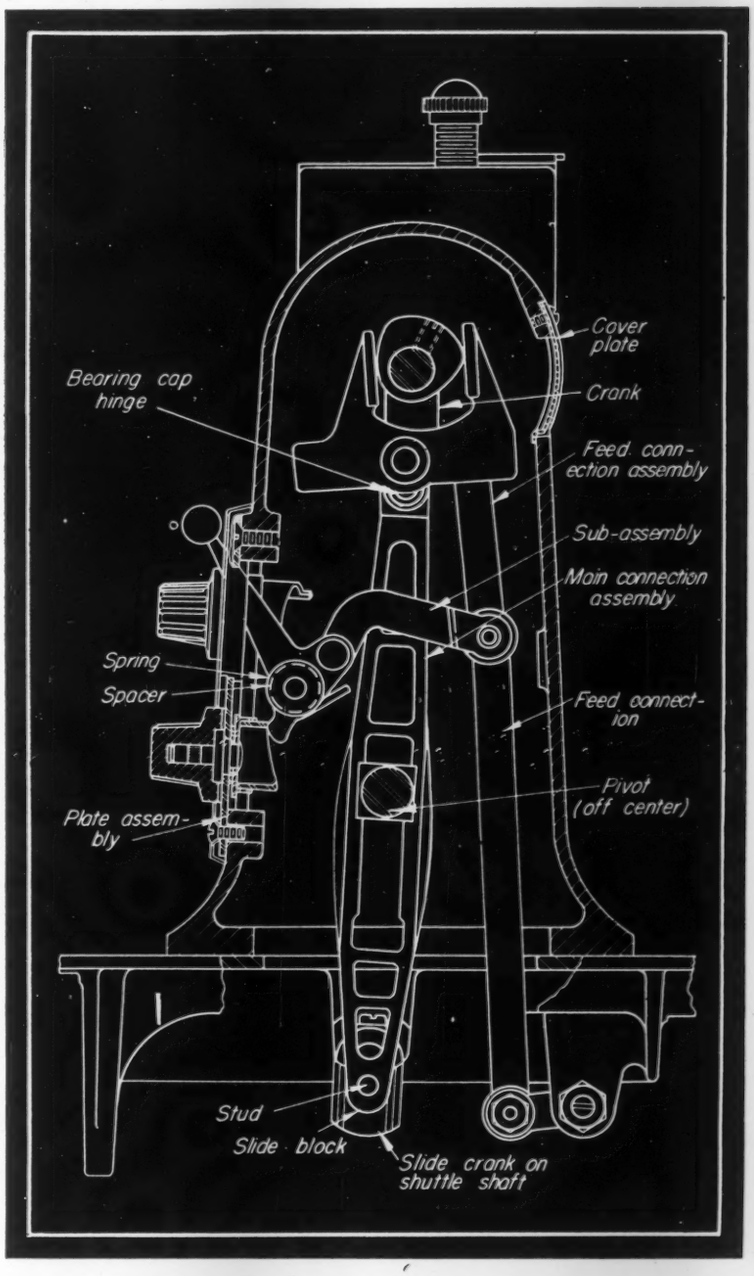
Illustrated in *Fig.* 1 is a typical sewing machine of modern design. Built by the White Sewing Machine Corp., it utilizes a rotary shuttle, the basic features of which were patented in 1897. Probably the most precise and critical component of the machine, the shuttle mechanism and its motions have been the subject of intensive research and development. One of three basic types —reciprocating, vibrating and rotating—the shuttle employed in this machine is typical of present-day refinements.

Each time a stitch is made the shuttle completes a full revolution. This is possible by varying the speed of the shuttle in its different angular positions. *Fig.* 2 illustrates the mechanism for obtaining this varying speed. An offset crank in the upper driveshaft operates a lever which slides on a pivot point about midway in the arm and which connects to a slide block on the shuttle shaft. Pivot point is off center, providing varying speeds.

Operating slowly when the feed is moving the cloth and completing the stitch, the shuttle travels faster after it has picked up the loop of the upper thread from the needle. Then, to pass through the loop as quickly as possible, the shuttle moves at maximum speed.

Referring to the exploded view shown in *Fig.* 3, the shuttle has a milled depression on its face. Serving as a cam for pulling thread off the bobbin, this depression

Fig. 2—Mechanism for driving shuttle at varying speed. Off-center pivot and slide block on shuttle driveshaft provide slow speed required while completing stitch



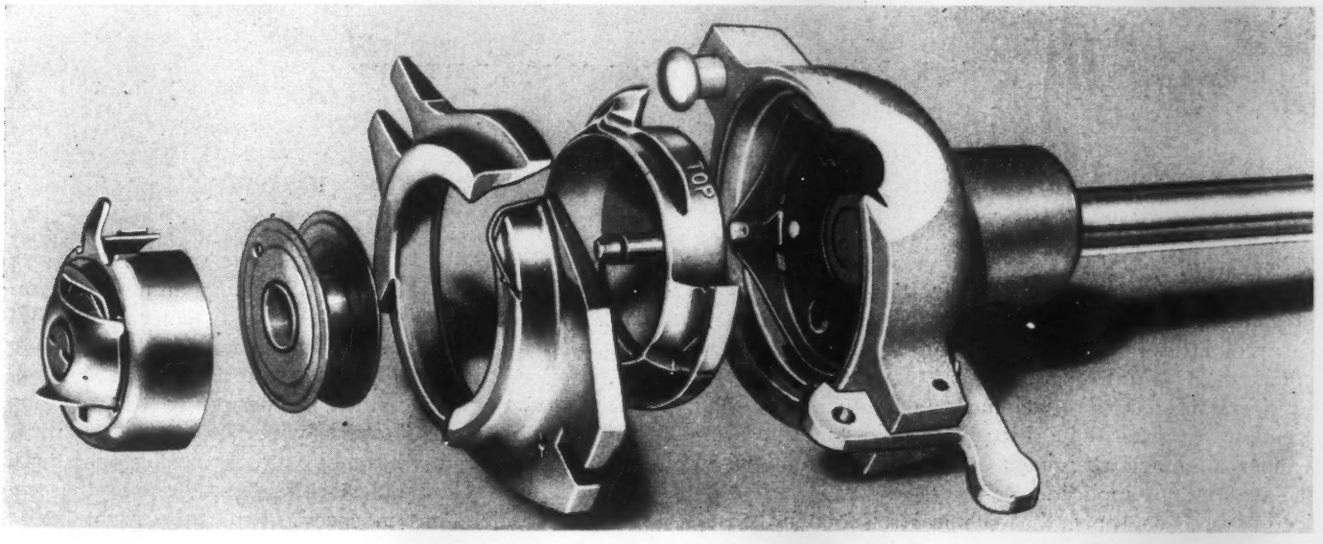
also releases the thread. While the thread is in the released position the take-up draws the upper thread through the needle plate. By releasing the bobbin thread at this position, approximately equal tension on upper and lower threads is attained, giving a desirable stitch form.

Bobbin is Easily Removed

The bobbin case is held into the shuttle by a latch that snaps into a recess in the shuttle stem. This latch also holds the bobbin in its case when removed from the shuttle. Holding the shuttle in place, the shuttle cover is easily removed if any threads are caught between it and the shuttle. The cover also prevents the bobbin case from rotating as there is a slot in it and a finger on the bobbin case protrudes into it.

When the machine operates slowly, the finger on the bobbin case has a tendency to vibrate back and forth, causing a ticking noise. The spring silencer shown on the shuttle cover absorbs this noise. In order that the thread will slide over it easily, the shuttle is ground and polished to a high finish. The shuttle race is machined so close to the shuttle in size that they are a snug fit when first put together. Prior to assembly in the machine they are run-in in a bath of oil.

Fig. 3—Exploded view of shuttle assembly showing, left to right, bobbin case, bobbin, shuttle race cover, shuttle, raceway housing and driveshaft



By E. J. Wellauer
Supervisor, Research and Metallurgy
The Falk Corp., Milwaukee, Wis.

WHICH CAST STEEL?

Part III—Influences of Processing Operations

IN THE first article of this series it was illustrated that a full range of physical properties is available in steel castings and that the particular alloy composition is of little importance except insofar as the alloying content affects the response to heat treatment or processing operations such as welding and machining. The second article presented a discussion of the standard specifications and their usefulness and limitations for general machine design applications.

With these concepts, the technical selection of a cast steel is reduced simply to the process of choosing a physical property specification which will meet the requirements of the design stresses and, if necessary, adding an additional note for heat-treated steels indicating the response to or depth of heat-treat penetration required. The remaining information in answering the question "Which Cast Steel?" obviously pertains to an investigation of the factors which relate to processing operations, particularly welding and machining, followed by the economic considerations in specification and design.

Fig. 10—Left—Cluster of steel power transmission coupling hubs cast centrifugally

Consideration of Processing Operations: The trend toward the use of alloy steels often has confused the machine designer as to the necessity of definitely establishing a chemical composition specification to complement a physical property specification. The confusion is increased by some 100 to 200 commercially used alloy combinations and many trade name variations.

Unless the designer has definite reasons for using a particular alloy composition, it is desirable to allow the supplying foundry to select a composition which will produce the desired properties. This procedure has several marked advantages. Every foundry has several standard compositions which are melted most frequently. Such standard compositions are selected to fulfill the requirements of the full range of standard specifications. Absence of a special chemical composition will enable the foundry to use one of its standard specifications with definite assurance that better delivery will be secured.

Of even greater importance is the fact that the individual foundry expends considerable research and development toward the perfection of the melting processes, founding techniques, and treating procedures of its standard analyses. The result is a more uniform product day in and day out because of the complete familiarity of all personnel involved as to the important characteristics of the particular steel during all phases of steel casting manufacture.

However, if certain alloys are needed for abrasion or corrosion resistance or service under extremes of temperature (topics not covered in this series of articles) chemical composition specifications are entirely justified. Insofar as general machine elements are concerned, chemical composition is important only as it affects processing operations required to completely manufacture and assemble the steel castings into the finished machine. Welding and machining are the two most important processes involved.

Welding: Insofar as welding of carbon steels is concerned, ASTM specification A27-46T adequately covers both chemical and physical properties. The practice of welding together alloy steel components which are to be heat treated or already are heat treated to high physical properties is commonplace in present day efforts to save weight or reduce dynamic stresses. In such cases, the preference of the welding department might be directed toward particular alloy compositions because of the experiences and techniques developed by the individual welding department. To utilize these techniques, a chemical composition might be discreet. As a guide, the designer can rely on the conclusions reached by many investigators including Smith and Bolton (1)* and Smith and Mueller (2) which show that the "weldability" of cast steel and wrought steel of the same chemical composition is almost identical. Welding experience obtained on rolled or forged steels can be applied to steel castings.

Weldability Dependent on Technique

The degree of weldability of any composition is influenced merely by the judgment exercised in the selection of proper welding technique and procedure executed by an adequately trained operator. If the designer has no experience with plant facilities and techniques, it is suggested that the foundry be consulted for recommendations of the best alloy composition suitable for welding and capable of meeting the required physical properties. All progressive foundries are in a position to make definite recommendations regarding proper welding procedures including rod types, rod sizes, currents, polarity, preheating temperatures, etc. For more complete recommendations pertinent to the use of steel castings in weldments, the reader is referred to a paper on the subject (3).

Machining: To specify adequately a material for a part which requires machine work, particularly if such machine work is extensive, is of a precision nature, or is a mass production operation, requires a study of the comparative machining characteristics regardless of whether the material is rolled, forged or cast steel. Unfortunately, the many intangible variables affecting machinability cannot be adequately analyzed and machinability comparisons must be determined by specific production experience.

As a guide to the designer who might have available data on wrought steels, it can be reported that cast steel has the same machinability as wrought steels of the same

* Numbers in parentheses indicate references listed at end of article.

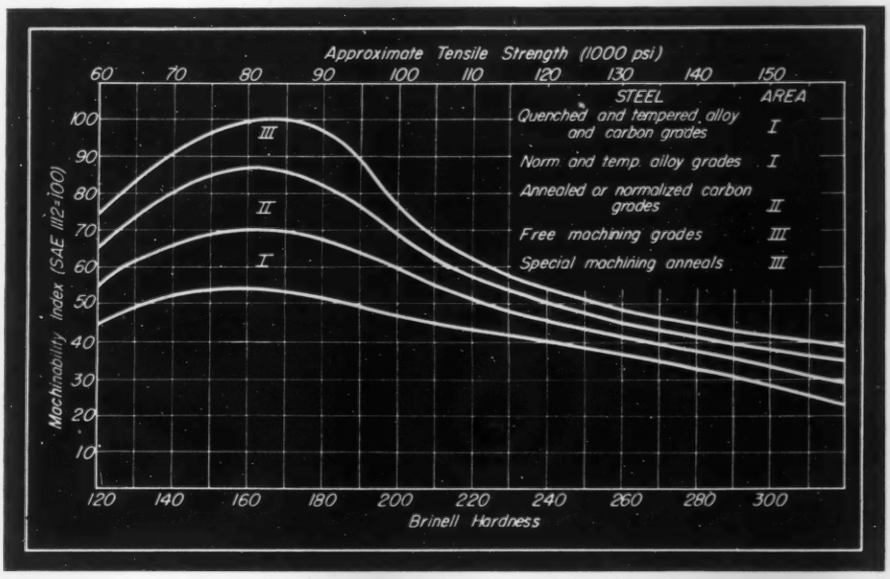


Fig. 11—Machinability of cast steels varies with hardness. Graph rates machinability of various grades comparatively with machinability of SAE 1112 steel

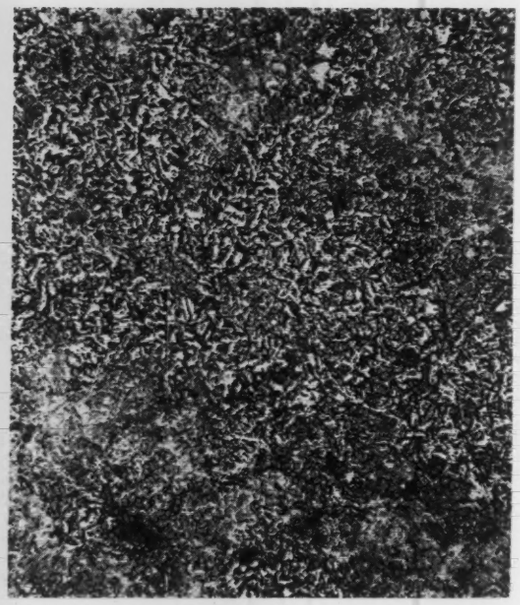


Fig. 12 — Metallurgical structural changes which can improve machinability of cast steel. Structure resulting from conventional furnace anneal is shown at left and structure after special treatment for better machinability is shown at the right

physical and metallurgical properties. This conclusion is based upon comprehensive studies of the machinability of cast steels reported by Wallichs and Associates (4). The author uses the machinability chart shown in *Fig.* 11 for both cast and forged steels.

Cast steel responds similarly to forged steels to various heat treatments which can improve machinability. Several

TABLE VIII
Carbon Extras

Under 0.20	extra
0.20 to 0.50	base
Over 0.50 to 1.00	extra
Over 1.00 to 1.25	additional extra

examples will illustrate this point. The curve, *Fig.* 11, shows lower machinability for hardnesses in the range of 120-140 brinell, which is common to low carbons. The decreased machinability usually is caused by tearing of the surface resulting in poor finishes. As with forged steels, considerable improvement, particularly in surface finish, results when a low-carbon steel is liquid quenched and tempered, markedly so if the hardness can be increased to about 180-210 brinell.

In the manufacture of rolled bars, considerable development has been made in the use of special "sub-critical, iso-thermal or cycle anneal" heat treatments to obtain optimum machinability. Cast steels can be given these types of treatments with equally efficacious results. For example, an SAE 4340 (chrome-nickel-moly) casting had the structure shown in *Fig.* 12 (left) after a conventional annealing treatment. The structure is seen to be very uniform, formed too long a chip, and resulted in a low machining rate.

A special cycle anneal was applied which resulted in the structure shown in *Fig.* 12 (right). The white islands are ferrite and were precipitated for the purpose of aiding to break up the chip. A substantial improvement in machining was secured. After machining, the steel was liquid quenched and tempered to a 200,000 psi minimum tensile strength. Metallurgical consultation is required to determine whether a particular steel will react to these special heat treatments for securing better machinability. A competent foundry metallurgist will be in a position to provide such advice.

Inspection Procedures: Having determined the physical properties, heat treatment and chemical composition (if necessary) the final technical problem remaining is that of determining the inspection necessary to insure the required quality for the contemplated service conditions. Cast steels can be tested for tensile properties, impact resistance at low, room, or high temperatures, brinell or rockwell hardness, pressure, etc. Freedom from harmful surface defects can be verified by the magnetic particle inspection method. Internal soundness of a proper degree can be ascertained by a radiographic examination.

Economic Considerations: Similar to the practices applied to steel mill products, the cost of steel castings is determined by a base charge plus extras for alloys, heat treatments, testing and special inspections.

Because of present changing economic conditions, it seems more advisable to list the factors which enter into the price determination of a steel casting rather than actual prices. With these in mind, the designer can be guided toward the most economical preliminary specifications which will fulfill the technical requirements. Final cost checks can be made with the foundry.

TABLE IX
Alloy Extras

Chromium (per cent)	**Vanadium (per cent)**
Under 0.90	Under 0.12
0.90 to 1.25	
Over 1.25 to 1.75	**Copper (per cent)**
Over 1.75 to 2.75	Under 1.00
	1.00 to 1.50
Nickel (per cent)	
Under 0.80	**Titanium (per cent)**
0.80 to 1.25	0.25 to 1.00
Over 1.25 to 1.75	
Over 1.75 to 2.25	**Molybdenum (per cent)**
Over 2.25 to 2.75	Under 0.20
Over 2.75 to 3.25	0.20 to 0.40
Over 3.25 to 3.75	0.40 to 0.60
Over 3.75 to 4.25	0.60 to 1.00
Over 4.25 to 5.25	

Note: There is no extra for manganese from 0.85 to 2.00 per cent.

Classification of Castings: The casting price is determined by the weight of the casting, the number of pieces and the classification which measures the work in-

volved in production. Cost of the casting per pound is reduced with an increase in weight and with an increased number of pieces on an order for any particular classification.

Extra. The following "extras" were selected as being most applicable for machine elements, are under the partial control of the designer and will be listed without explanations unless required for clarification.

Carbon extras: These, TABLE VIII, apply to castings given a single heat treatment such as one anneal or one normalize. Any additional treatment such as a temper after normalizing or liquid quenching adds an extra. Whenever alloy compositions or tension inspection is specified, the extra for carbon is eliminated. Standard carbon ranges are 0.10 per cent, and each 0.01 per cent carbon restriction below the standard range involves an extra charge. In no case can the total carbon range be specified as less than 0.05 per cent.

Alloy extras (without tension specifications): Similar to rolled steels, the price of alloy castings is computed by adding to an alloy base the extras for the particular alloy additions and ranges specified. The alloy extras are compiled in TABLE IX. The extras increase with each increased range of alloying.

Extras for Quench and Temper Treatments: The alloy extras are based upon only a single anneal or single normalize. An extra is involved for each additional heating operation required, modified on the basis of the total weight of castings ordered at one time to one pattern. This extra is not applied for castings requiring a liquid quench and temper to secure specified hardnesses or physical property specifications.

Hardness Specifications: The carbon content, alloying and heat treatment required to obtain specified hardness determine the price. The usual hardness specification is limited to a range of 50 brinell numbers between the minimum and maximum specified.

Tension Specifications (without chemical composition specifications): These depend on the ASTM grade specified. If nonstandard minimums are ordered, the extra for the next highest grade applies.

Tension Specifications Plus Alloy Composition Specifications: When both are specified, the price is determined by the highest extra for either the tension specification or the chemical composition plus an additional amount.

Additional Tensile Test Bars: When the number of physical tests exceed those called for in the ASTM specifications, an extra charge is made for each extra bar. The cost varies for rough-cast bars, machined bars and test bars with certified reports.

Special Tests: These are charged as follows:

Pressure Tests—Percentage increase.

Impact Tests—Charge per test varies with temperature of test.

Radiographic Tests—When rejection is determined by radiographic standards, a percentage increase in price is made. All other radiographic inspection

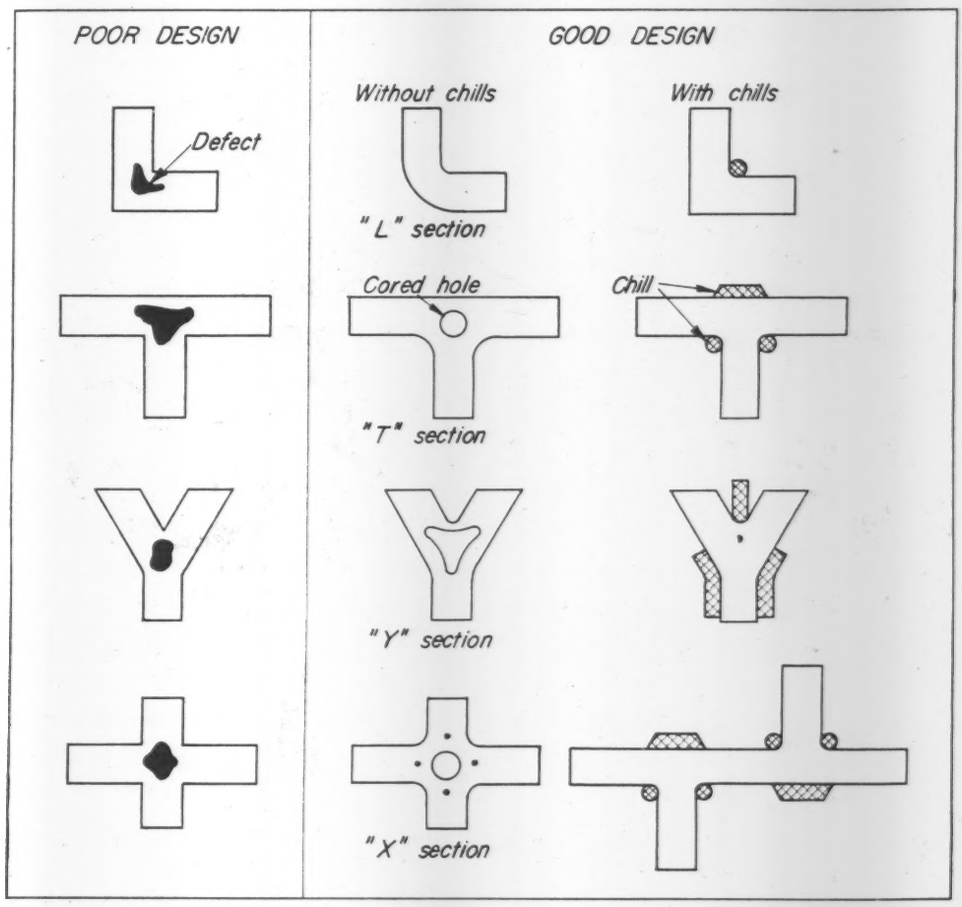


Fig. 13—Illustrations of poor and good designs of basic sections for steel castings

is charged on an hourly rate which depends on the radiographic equipment used for the test.

Magnetic Particle Tests—When rejection is determined by a magnetic particle test, a percentage increase in price is made. All other magnetic particle inspection is charged on an hourly rate.

Designers will recognize the fact that these extras are similar to those experienced when ordering products from steel mills and the same studies of specifications to utilize standard ranges, etc., will result in similar economies.

Cost of pattern equipment is important and will vary depending upon the size of the casting, the number of castings to be produced, and the foundry production equipment available. The cost of patterns for the manufacture of a few pieces will be lower than that for patterns required to produce in volume as, for example, by the centrifugal method, *Fig.* 10. As the volume increases, the more economical it becomes to manufacture specialized pattern equipment to promote production.

Design Considerations: No designer would expect to revise a machine element from a forging to a weldment without a complete revision of the elements. Even in new designs the basic attack of the problem would be vastly different. Similarly, when designing for the use of steel castings, due allowances must be made for liquid and solid shrinkage, progressive solidification, elimination of defect-forming contours, methods of mold preparation, production techniques, etc. As an example, *Fig.* 13 shows various simple basic sections indicating the effect of poor and good designs.

Design considerations for large steel mill gears 16 or more feet in diameter as illustrated in *Fig.* 14 differ only in degree from those involved in the design of a 16-inch diameter cast-steel gear. The benefits of good design are not limited to large or intricate castings but can be equally as effective for small or simple castings. Good quality, superior performance and low cost are all dependent upon good design. The paper by Briggs, Gezelius and Donaldson (5) is highly recommended for study by designers not well versed in the fundamentals of steel casting design. The design of a steel casting is not greatly affected by any particular chemical composition. Castings required to be liquid quenched must be carefully considered to minimize sectional thickness differences or similar factors which might be conducive to cracking during heat treatment. Consultation with the foundryman throughout all the phases of design is certain to result in substantial return.

Fig. 14—Design of these cast-steel steel-mill gears involved considerations similar to those encountered in designing much smaller cast gears

References

1. Smith and Bolton—"The Effect of Welding on the Structures of Some Cast and Wrought Steels", *Transactions,* American Foundrymen's Association, September, 1940.
2. Mueller, Smith and Oesterle—"Welding of Medium Carbon Steel Castings by the Metal Arc Process", *Transactions,* American Foundrymen's Association, Vol. 50, 1942.
3. Wellauer—"Steel Castings—Their Properties and Use in Weldments", Welding Research Council—*Supplement to the Journal*—American Welding Society, April, 1944.
4. Wallichs—"Actual-Maschinenbau", *Giesserei,* Vol. 9, 1930, pages 257-262; *Giesserei,* Vol. 17, 1930, pages 325-329; *Giesserei,* Vol. 19, 1932, pages 241-247.
5. Briggs, Gezelius and Donaldson—"Steel Casting Design for the Engineer and Foundryman", *Transactions,* American Foundrymen's Association, Vol. 46, 1938.

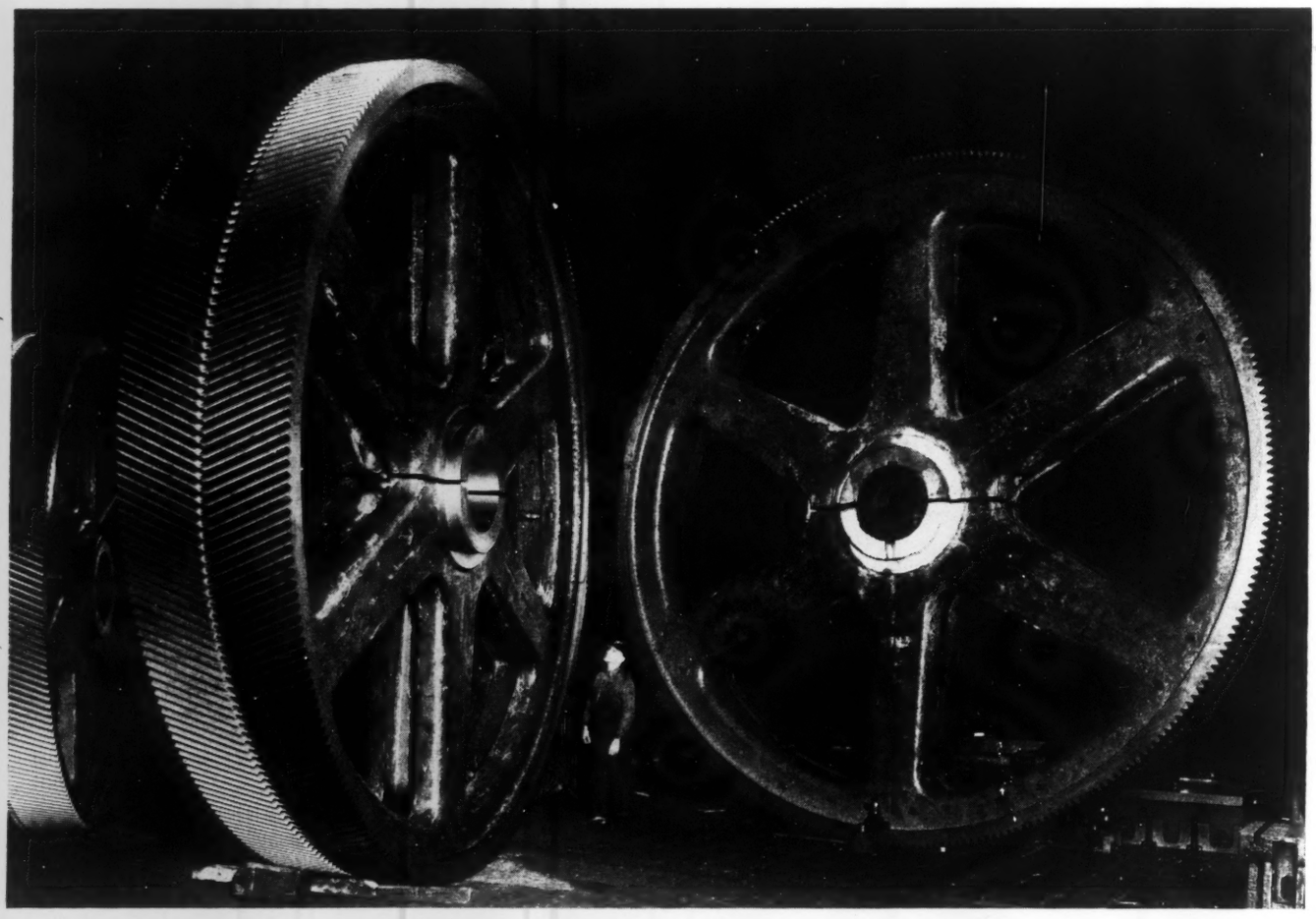


Fig. 1—Controls of machine are readily accessible, yet protected by skillful recessing

Unique Dictating Machine

. . . achieves constant recording speed on disk type record by novel frictional drive and feed without turntable

By Frank L. Moore and Robert J. Schneider

The Gray Mfg. Co.

Hartford, Conn.

INCORPORATING new materials and new design concepts, the Gray Audograph, *Fig.* 1, is a compact business machine providing instantaneous voice recording and reproduction. It provides remotely controlled starting, stopping and back-spacing of the records employed which are permanent flexible plastic disks that may be played back as often as desired and can be readily filed or mailed.

Design of this sturdy portable machine, incorporating all desirable features, required concerted effort to simplify all components and, finally, discriminating choice in the arrangement of subassemblies. This approach has resulted in ready accessibility of all component parts, simplicity of construction and a high degree of compactness.

The machine operates at a constant groove speed, assuring uniform recording quality at all radii of the record and contributing materially to the record economy achieved. A record eight and one-half inches in diameter provides over a half hour of continuous recording on each side. Recording 260 grooves on every inch of record

radius, each groove is less than one-thousandth inch deep and two and one-half thousandths inch wide. Approximately 600 revolutions are required to fill one side of a record (a groove approximately the length of three city blocks). Constant groove speed in contrast with constant angular velocity eliminates all compromise with variable recording speeds and variable recording quality which heretofore have characterized phonographic and disk recording equipment. Constant groove speed is attained through the elimination of the customary turntable and the use of a screw-driven record carriage and a fixed drive roller turning at 100 revolutions per minute. The useful carriage travel on the current model is two and one-quarter inches. Details of this mechanism are shown in *Fig.* 2 which also shows how a manually operated control knob is connected with the carriage by means of a bronze cable, used also to drive the indexing mechanism.

Recording and reproducing stylii, mounted in the same head, do not move across the record during recording as is customary practice. Rather, the record moves relative to the stylii. This procedure is made possible by the unique manner in which the record is driven in rotation and traversed in a direction parallel to the front of the machine. Drive from the motor, *Fig.* 3, is by flat belt, first to an intermediate pulley and then to a pulley on the shaft which mounts the record-driving roller. By this means the high speed of the motor is reduced to the slower speed required of the drive roller.

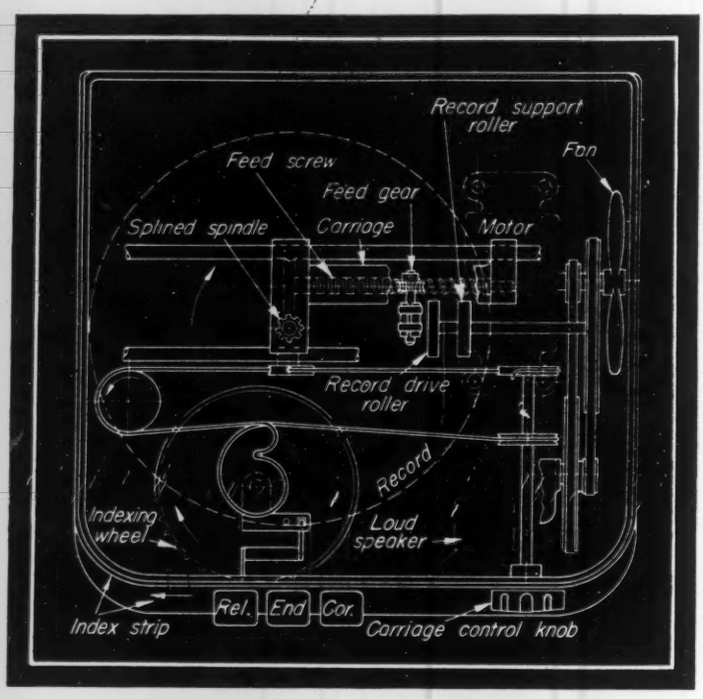
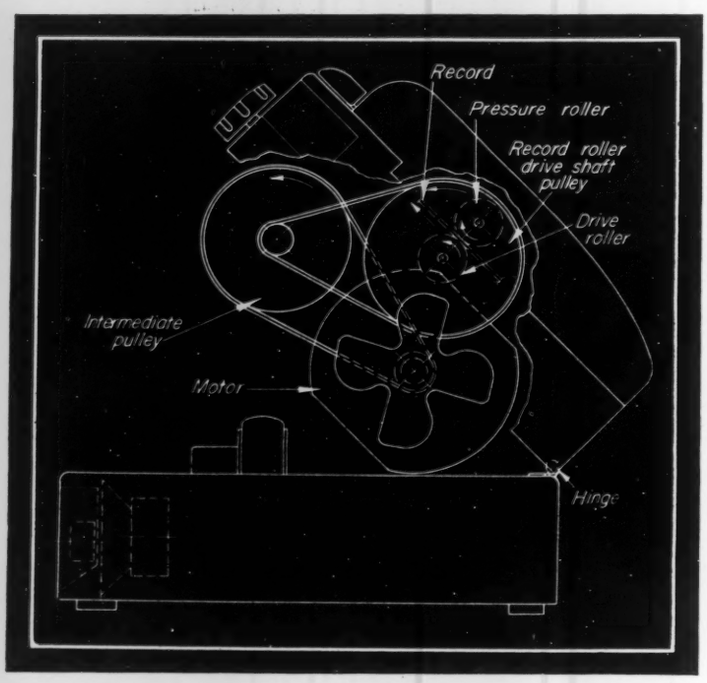


Fig. 2—Above—Carriage feed and record driving mechanisms, showing cable drive for feeding carriage manually

Fig. 3—Below—Drive from motor is by flat belt to intermediate pulley for speed stepdown, and then to pulley on shaft which also mounts the record drive roller



Absence of Turntable Yields Advantages

No turntable is employed on the machine, the record being supported on its underside at the point of stylus contact by a roller mounted adjacent to the drive roller. Thus, the inertia of a turntable is eliminated, insuring instantaneous starting and stopping of the record and decreasing the overall weight of the machine.

It will be noted in *Figs.* 1 and 2 that the hole in the record center matches the splined spindle which is driven by the record. A worm on the spindle shaft meshes with a worm wheel. This in turn

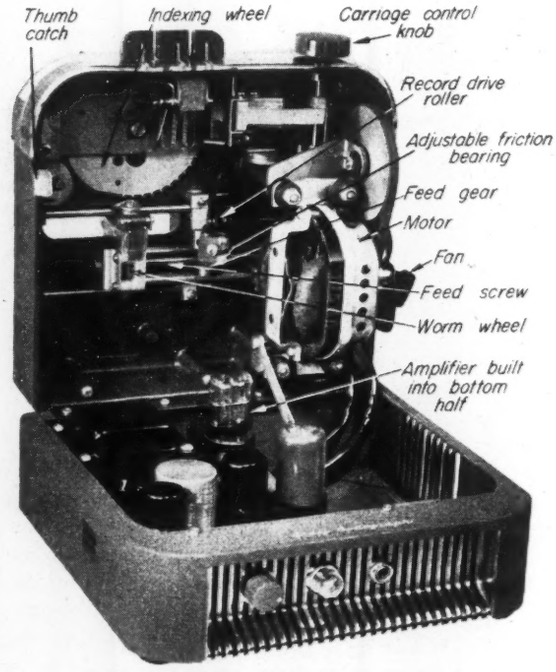


Fig. 4—Mechanical units are mounted in upper housing while lower housing contains amplifier. This procedure simplifies manufacture and servicing

drives the feed screw which meshes with the feed gear. In effect, the feed gear is a small worm wheel, the shaft of which is mounted in an adjustable friction bearing. The resistance to rotation imposed by this bearing is sufficient to prevent turning of the feed gear during recording. Thus, as the feed screw rotates in mesh with the feed gear, it propels the carriage in a direction parallel to its axis. This mechanism is also shown in *Fig.* 4 which shows the machine with its upper and lower halves swung open to permit servicing.

Mechanism Permits Quick Manual Indexing

Instant location and playback of any portion of a recording results from this control. It permits the operator to select any point on a record by the simple rotation of the knob while the machine remains in operation. This ease of operation is achieved through overcoming the friction in the feed-gear bearing without mechanical disengagement of the feeding mechanism, a feature which greatly simplifies control.

Simplicity of the belt drive is shown in *Figs.* 2 and 3. A special impregnated belt material is employed. It was developed from a material initially used during the late war in the drive system of automatic mechanically operated beacon markers, where continuous performance was required in the presence of salt spray in a highly humid atmosphere throughout temperatures that varied widely.

Design of the start-stop assembly is shown in *Figs.* 5 and 6. The pressure roller holds the record firmly against the drive roller when recording or reproducing is in process. Motion of the record is stopped manually by release of the pressure roller when the record-listen lever is in neutral position, because a tab on the swivel plate lifts the pressure roller arm (*Fig.* 6). The same result is achieved electrically by means of the start-stop coil shown in *Fig.* 5. As a result of the electrical arrangement of the start-stop magnet, fed from the direct-current supply of the amplifier, the entire mechanism is always in instant readiness. These characteristics assure not only the immediate response of the machine to the most exacting demands of the user, but also the clarity of the initial and final syllables of a dictation.

Combined magnetic recording and playback reproduction sections of this machine are built into a single unit. The recorder and the reproducer portions of the unit utilize a common magnet but separate coils and are held effectively rigid during both recording and reproduction. Separate vibratory systems, including stylii, are used to obtain optimum performance in each case. The combination recorder-reproducer unit, (*Figs.* 5 and 6), is rocked or pivoted on an axis located just above the magnet and is brought into engagement with the record by alternately lowering the front or sapphire reproducer stylus and the rear or diamond recorder stylus in the manner illustrated in *Fig.* 7. This combination design permits instantaneous selection of either the recording or reproduction position by a flip of the single record-listen switch.

This machine will make recordings or transcribe with the same performance when subjected to shock, turned upside down, or operated in any other position—characteristics which make it suitable for many types of mobile operation.

When the machine is used as a transcribing device the

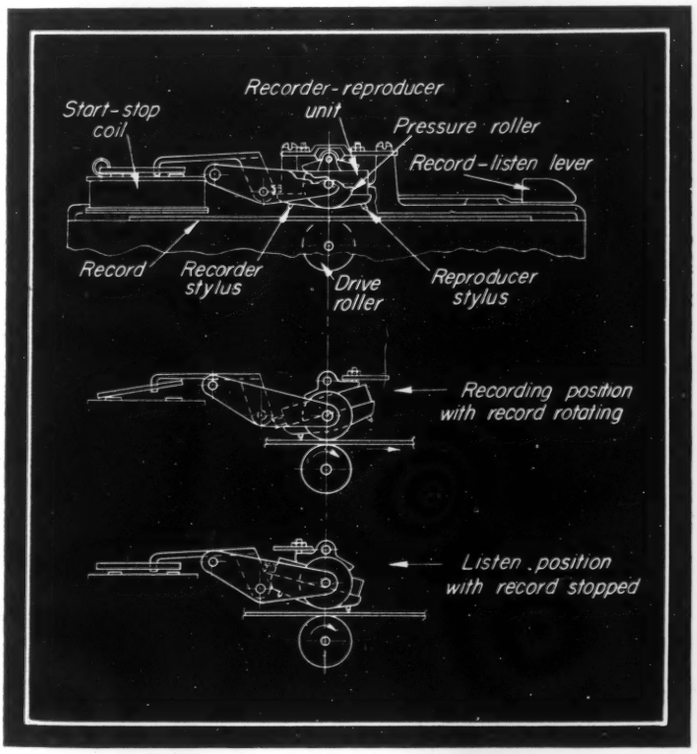
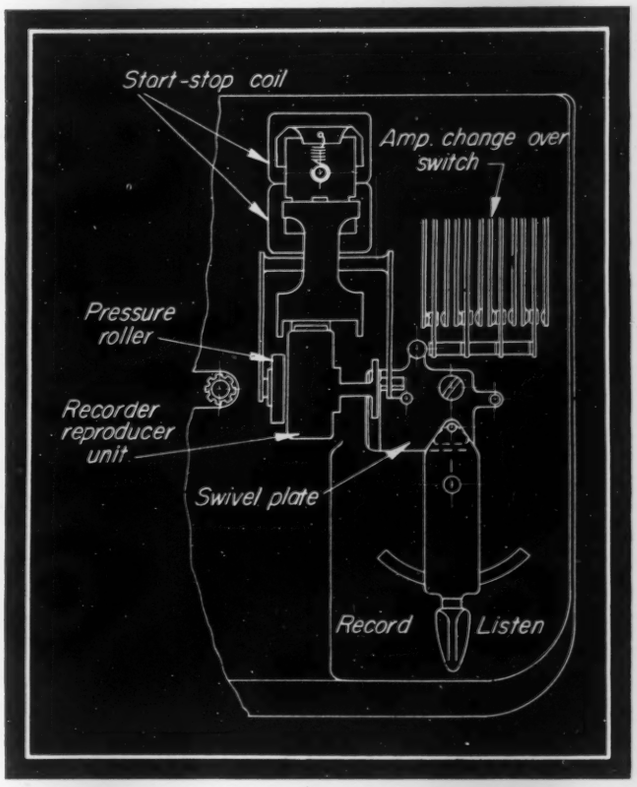


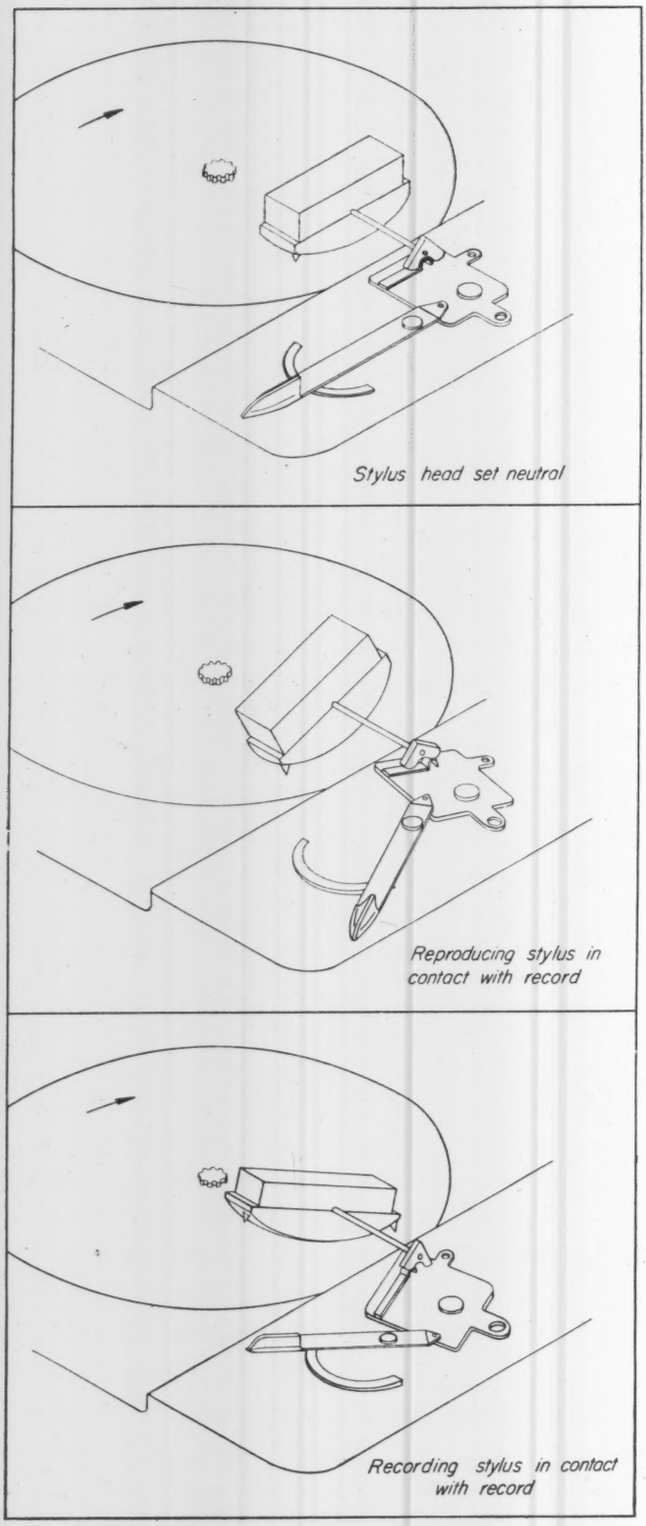
Fig. 5—Three views show how start-stop coil is employed to position pressure roller when record-listen lever is in neutral, recording or listening position

Fig. 6—Mechanism through which record-listen lever controls the record-reproducer unit, the amplifier change-over switch and the start-stop pressure roller



contents of the record may be examined at will by means of an indexing mechanism accompanied by the use of the built-in speaker. Operation of the indexing mechanism is controlled by three keys, *Figs.* 1 and 2. Two of these actuate a die-punch, which perforates a paper index strip. By this means the operator may indicate to the transcribing typist any selected position on a given record. These two keys are marked for perforating the index strip to indicate end of letter and corrections, respectively. A third key is provided for inserting and releasing the index strip. To achieve simplicity and flexibility it was found operationally desirable to have a moving index strip rather than to move the punch and die mechanism.

Fig. 7—Below—How recording and reproducing stylii, in common head, are positioned by record-listen lever



For simple and foolproof operation of this index strip it is necessary to translate the radii of the record into a linear index means by use of a cam and cable arrangement familiarly used in the radio industry for a number of years. From *Fig.* 2 it may be seen how, through the cable and cam mechanism, the radial motion of the record is converted into the linear motion of the indexing strip. This is accomplished by passing the carriage control cable around a properly designed cam. The operation of the mechanism and the position of the index strip is automatically controlled by the movement of the record carriage, an arrangement which insures that the position of the record is always accurately synchronized with that of the index strip.

Although a record may be back-spaced manually by means of the control knob while the machine remains in operation and the reproducer stylus is in the groove, automatic remotely controlled back spacing also is provided. This is accomplished by means of a magnet with a pawl engaging a ratchet on the control knob shaft. In this manner the carriage is brought back radially a groove or two at a time against the frictionally driven carriage feed without the necessity of stopping the operation of the machine.

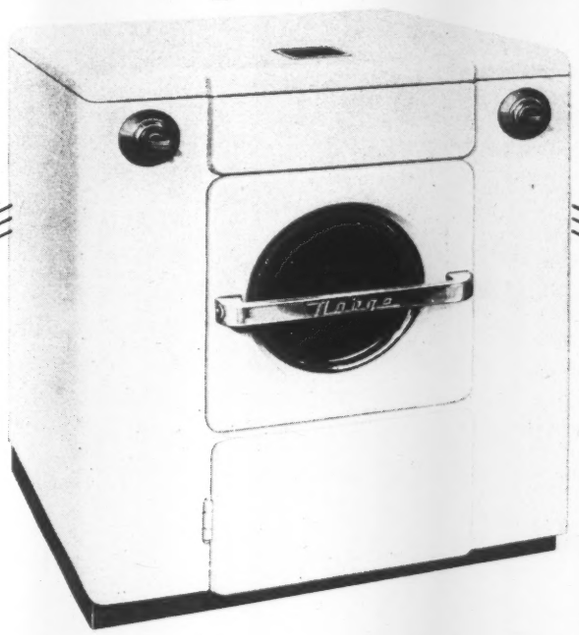
The "end of record" signal is an extremely simple device which begins automatic operation when the recording stylus is the desired distance from the outer periphery of the record. It consists of a striker operated by the record itself and, therefore, assures automatic performance without adjustment regardless of the size of the record.

Materials Used Closely Evaluated

Throughout the development of the machine, great importance was placed upon utilization of the most improved materials for each function. At all stages, research was conducted into the suitability of the various newer metals and electrical components. A number of valuable suggestions resulted from a careful review of announcements in trade journals, scientific literature and advice from various vendors' sales organizations.

A few of the materials which made possible this unique design are the Alnico 5 magnet in the recorder-reproducer unit, compact resistors originally developed for use in the proximity fuse and several of the newer plastic resins. Die castings and various special stainless steels are used for a number of parts. The larger parts are constructed almost entirely of aluminum. A new type of plastic-covered wire was found to possess both electrical and mechanical advantages in the construction of this extremely compact machine.

All parts are readily accessible. The upper and lower halves of the machine may be separated without using a tool, by exerting thumb pressure on a convenient engagement catch and swinging the halves apart as shown in *Fig.* 3. The lower half of the machine contains the compact high-gain amplifier section along with an attached loud speaker.



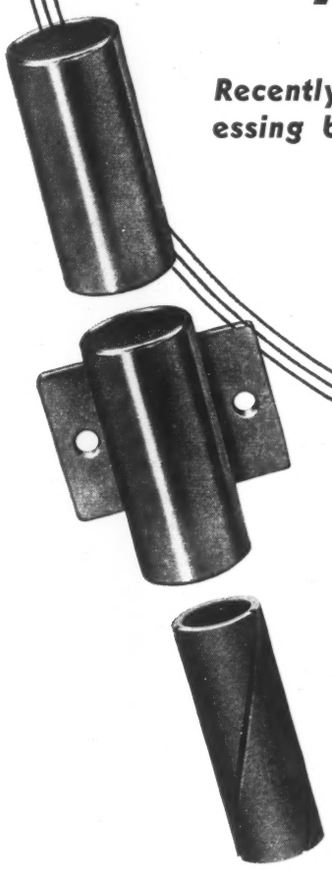
Porcelain Enamels

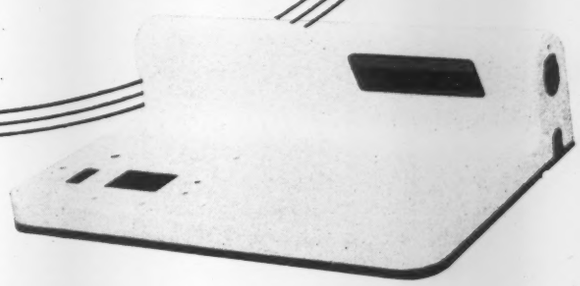
FOR MACHINE PARTS

Recently developed enamels and improved methods of processing broaden the field of porcelain enamel application

By R. L. Fellows

Assistant Director of Research
Chicago Vitreous Enamel Product Co.
Cicero, Ill.





PORCELAIN enamel, a glass which can be intimately fused to a metal base formed in practically any desired shape, is finding increased favor and use in diversified industries because of its pleasing appearance, permanency of color, corrosion resistance, ease of cleaning and ability to withstand high or low temperature extremes. These qualities as well as others have made it a desirable and satisfactory finish for many machine parts employed extensively in both the com-

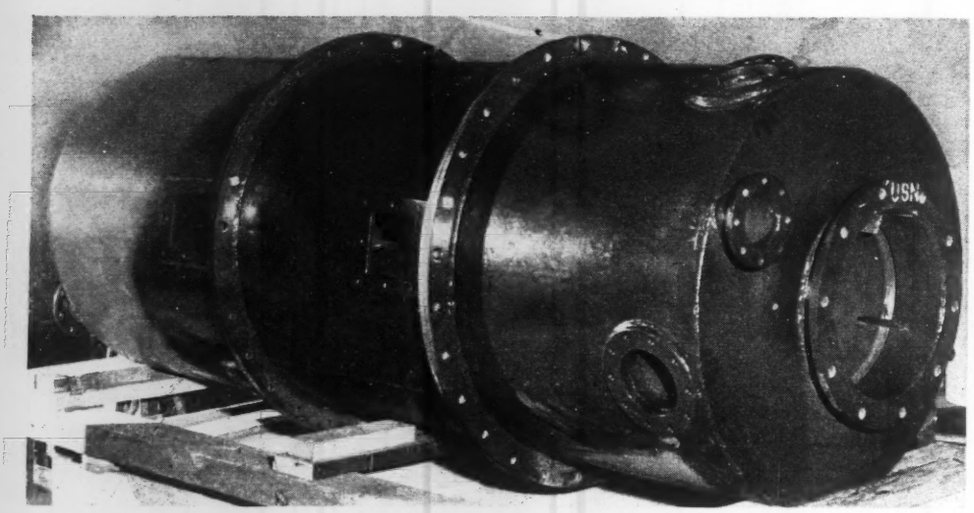


Fig. 1—Application of newly developed porcelain enamel to this submarine exhaust silencer served to greatly lengthen its life

mercial and domestic fields.

Although the use of porcelain enamel for many items was restricted during the war because of the lack of steel, many new enamels, new uses and new methods of application, as well as new types of enameling sheets were developed during this period. Many of these now are being employed commercially, while others are still in the experimental stage. Some are unfolding new possibilities for the use of porcelain enamel through the employment of lighter coatings and lower firing temperatures. Also, many other applications are being uncovered through the development of enamels for a wide variety of specialized purposes.

Adequate Protection from Single Coat

Corrosion-Resisting Enamels: Porcelain enamel is a proved corrosion resisting finish. Only a single ground coat often is all that is necessary to achieve complete protection. The performance of ground coat on oven linings in cooking ranges affords an excellent example. In the past, without a porcelain enamel coating, oven linings became rusty and unsightly in a short time. Through the use of porcelain enamel, oven linings now last indefinitely. During the war, submarine exhaust silencers, *Fig.* 1, were enameled with a newly developed porcelain enamel for these heavy gage parts. The coating increased the life of the exhaust system tremendously and thereby reduced the time required in port for overhaul.

New developments include soft ground coats available in a wide range of color which now are being used in large quantities on circulating heaters and on many other items where a pleasing appearance is desired and a corrosion and heat-resistant finish is required. A single coat application of these enamels is fired on the ware at approximately 1500 F.

Acid-resisting ground coats have been developed which by themselves are especially adaptable for protection of products that are exposed to acid conditions such as flue gases, coal, etc. Large quantities of pipe and fittings for the rubber industry, *Fig.* 2, were coated with this type of corrosion resistant porcelain enamel during the war. In this industry, periodical cleaning of the equipment is necessary and it was found that the porcelain enameled pipe afforded ease in cleaning and the saving of many man hours of labor for this purpose. These ground coats also have been used in combination with tinning for the protection of the metal. After the ground coat has been applied and previous to firing, the bisque enamel may be removed from any specified area by brushing. After subsequent fusion of the porcelain enamel, the oxidized steel in those areas from which the enamel has been removed is cleaned by suitable acid treatment preparatory to tinning. This process has no detrimental effect on the enamel. In the hot-dip tinning operation the tin will adhere to the bare metal, but will not adhere to the porcelain enamel. This makes it possible for designers to combine easily these two types of finishes in a product.

Heat-Resisting Enamels: A new type of heat-resisting porcelain enamel was developed during the war for exhaust systems for aircraft and naval vessels. These special formulas have a mat finish and are applied on ordinary steel at a thickness of 0.001 to 0.003-inch. They have high thermal shock resistance, will withstand prolonged heating at 1300 F or higher, and were found to outlast many other materials employed for these purposes. Many parts of exhaust systems used in automobiles, tractors, or airplanes, *Fig.* 3, might well be protected with this type of coating.

Enamels Used on Jet Engines, Gas Turbines

Other applications of new type refractory corrosion-resistant coatings have been developed for even higher temperatures on parts to be used in jet-propulsion engines, gas turbines, etc. In many cases, it has been found advantageous to coat stainless steel or other heat-resisting alloys with enamels of this type to increase their life. No doubt there are many places in industry where similar coatings might be used to good advantage.

Unique Uses for Enamels: An interesting application for porcelain enamel is found in the manufacture of certain electric-motor parts which are subject to continuous abrasive action. In actual service, the porcelain enameled surface has outworn all other materials that have been tested.

The electrical field opens up interesting possibilities for porcelain enamel because of its dielectric properties. Par-

ticularly in electronics, several developments have come about which are at present of confidential nature and cannot be revealed. Several of these are past the development stage and have fully justified the design engineer's confidence in the material.

A specialized corrosion problem in aluminum was solved with enamel coating by the Germans. Piston heads of diesel motors were subject to failure in service due to intergranular attack by the combustion gases. A light coating of special enamel for the aluminum increased the life of the piston head.

ENAMELS FOR ALUMINUM: Because of its low melting point, aluminum requires a soft enamel that will mature at a low temperature. Recent developments in the enameling of aluminum have been encouraging. The most satisfactory results are obtained by cleaning the aluminum in a degreaser and then giving a dichromate dip prior to the application of the enamel. The porcelain enamels for aluminum usually are applied in two coats, the ground coat being of somewhat different composition than the second or cover coat. Both the ground and cover coat enamels are fired at between 900 and 1000 F. Since enamels for application on aluminum may be produced in various colors, many items made of aluminum may be protected from corrosion and at the same time beautified.

Number of Fluxes Limited

There is a limited number of fluxes that may be used to obtain enamels that will mature at these low temperatures. Litharge is one of the most satisfactory fluxes for this purpose because it forms a more insoluble glass. Since enamels for aluminum usually have a high lead content, this type of enamel is not recommended for food handling equipment. Although some of the enamels have good acid resistance, all are not entirely insoluble in water.

WHITE COVER COATS: Just prior to the war, the trend was toward the use of zirconium opacified white cover coat frits and now these have largely displaced the antimony opacified frits. The advantage of the zircon frits is increased opacity, broader firing range and better workability. The increased opacity allows for decreased thickness of coatings, while the broader firing range makes it possible to fire ground coat and cover coat at the same time and temperature cycle, thus facilitating production.

More recently, enamels opacified with titanium oxide have been finding use in industry. These enamels, which may be made with good acid resistance, develop considerably more opacity than the previously mentioned types of cover coats. By their use, it is possible to cut the weight of application of the white enamels in half. This reduces the total thickness of ground coat and cover coat enamels from a minimum of 0.010-inch for the zircon opacified enamel to 0.005 to 0.007-inch for the titanium. This reduction in the thickness of the enamel is important in the design of products, as generally the thinner the application of the enamel the more serviceable the product.

Also, greater flexibility may be achieved through the use of these lighter coatings.

ONE-FIRE WHITE ENAMELS: In the past few years, through combined efforts of the enameling iron manufacturers and the manufacturers of porcelain enamel frits, great strides have been made in the application of one coat of white enamel direct to the iron without the use of the conventional dark ground coats. White enamels when applied direct to regular enameling irons usually lacked adherence and caused many other enameling difficulties. Improved enameling irons and enamels were developed to overcome these problems.

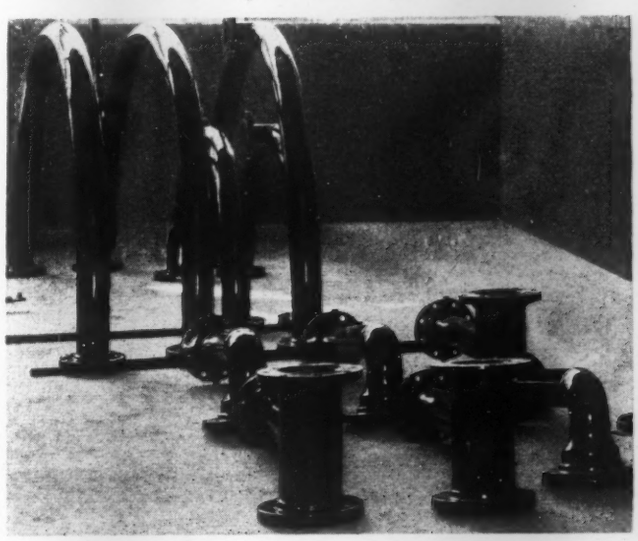
How Enameling Sheets Are Improved

In the development of the special enameling sheets to which new one-fire white porcelain enamels were to be applied, several methods of minimizing the obstacles were utilized. Modifications in the processing of the iron to reduce the amount of impurities and thereby decrease the boiling tendency have been found to give promising results. Some steel manufacturers have found that the subsequent boiling and blistering in the enamel originating from the iron may be reduced by the addition of titanium prior to pouring the molten metal.

The above two types of enameling iron require a nickel flash treatment in the cleaning and pickling process to produce adherence. The nickel dip consists of several minutes immersion of the freshly pickled enameling iron in a hot nickel sulphate solution of approximately two ounces of single nickel salts per gallon of water. This treatment deposits an imperceptible coating of nickel on the ware by galvanic action. The white porcelain enamels that have been developed for direct application to these enameling irons usually are fired at about 1500 F and extreme care is necessary in their application to make sure that the iron is adequately covered with an even coat to avoid burned-through areas.

A third type of enameling iron is made by electro-plating "cold rolled" steel at the mill. The enamels for this type of steel are designed to fire at about 1300 F to take advantage of the fact that the carbon present in the steel does not decompose at this temperature. This prevents blistering and boiling in the enamel. To prepare this type of iron for porcelain enameling, only a cleaning process to remove the oil and grease usually is recommended, but a light acid pickle and subsequent neutralizing sometimes is desirable. Due to the presence of adherence promoting

Fig. 2—Corrosion-resistant enamel on pipe and fittings used in rubber industry facilitated periodic cleaning



metals on the sheet, a nickel flash is not necessary, but careful control of the application and firing of the white enamel is imperative.

It may be found that the cost of these new enameling sheets is higher than ordinary enameling stock, but the potential savings in number of coats required will no doubt more than offset this cost in many instances. This reduction in number of coats makes it possible to obtain a suitable white enamel at an application as thin as 0.006-inch compared to 0.010 to 0.015-inch for ordinary enamels.

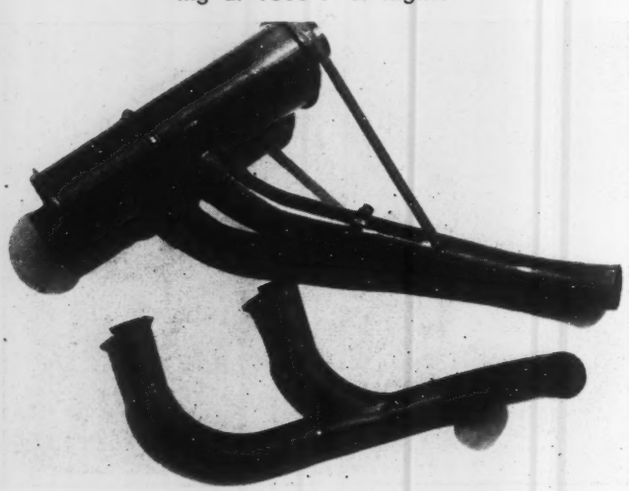
Ordinary cold-rolled steel also has been enameled with fairly good success using the white porcelain enamels that fire at 1300 F. It is necessary, however, to give the steel a sufficiently heavy nickel flash treatment. This nickel coating must be carefully controlled in order to secure satisfactory adherence, but the results usually are not as consistent as when plated sheets are used.

The lower firing temperature of these enamels affords several advantages which are beneficial to design. Steel sheets will sag considerably due to their own weight when heated to 1550 or 1600 F, but comparatively little at 1300 F. Warping and distortion of the ware also is reduced when the lower temperature is used. This reduction in warping and distortion is especially noticeable on parts that have been formed or welded. These factors facilitate the enameling of larger and more complicated shapes as well as the use of lighter gages of metal.

It must be remembered that these low-temperature, one-fire white porcelain enamels are still in the development stage. However, many suitable applications undoubtedly will be found for these enameling stocks and enamels.

Improvements in Processing: Although the use of multiple-cleaner tanks has been common practice in many plants, some manufacturers of cleaners are now marketing a combination of cleaners in which the first tank has a different composition from the second tank. I the first, a low pH or an emulsion type of cleaner is employed, while the usual alkali type of cleaner is used in the second. By this means the soil is loosened and partially removed in the first tank and is much more easily removed by the alkali cleaner in the second tank. Many enameling plants have found it advantageous to preclean parts after fabrication by using "washers" which remove the drawing compounds and leave the parts in a condition which is more readily cleaned by the normal process.

Fig. 3—New type heat-resistant porcelain enamel on aircraft exhaust system parts will withstand prolonged heating at 1300 F or higher



More mechanical or continuous pickling equipment is being adopted than ever before. Automatic temperature controls, softened water, filters for the nickel sulphate tank, and more exact chemical control of the solutions are all contributing toward the securing of improved results. Some plants are making use of spray cleaning and pickling. This is adaptable to certain types of ware in which all the surfaces can be economically reached with the spray.

Another type of cleaning, in which the ware is heated from 1450 to 1700 F in a reducing atmosphere, results in a bright metal surface to which enamel may be applied without further treatment. It is reported that highly satisfactory enameling results are being obtained on parts processed in this manner.

The industry is progressing through the use of more automatic spray machines, water-wash spray booths and by spraying in plenum chambers (spray rooms under pressure). Automatic spray machines afford the means of maintaining application weights of enamel within close limits. By keeping the spray rooms under pressure and using filtered air, the number of blemishes due to airborne contamination is kept to a minimum. Through these better operating conditions, it is possible to reclaim better than 90 per cent of the oversprayed material and re-use it without impairing quality.

Application by Electrostatic Spraying

Applying porcelain enamels by electrostatic spraying has been found suitable for certain types of parts where production is sufficiently great. In this novel method of application, the porcelain enamel is introduced into a chamber in the form of a mist. Electrode wires in this booth constitute the negative pole of an electrostatic field, and the parts to be coated act as the positive pole. The porcelain enamel particles take on a negative charge and are effectively attracted to the surface of the ware, thus minimizing the amount of overspray. To use this process successfully, it is imperative that close control be exercised over the milled enamel, as well as over the atomizing pressures. There are several limitations which make the process best suited for flat surfaces or the exteriors of symmetrically shaped parts.

Utilization of infra-red radiation has proved practical for drying certain types of parts. More efficiency is secured in this type of drying when the radiation is employed with dark colored enamels, since the energy is reflected by white coatings.

In the last few years many new chemicals and materials have been used as mill additions to control the properties and increase the workability of the enamel slips. Along with them more careful control of the physical properties of the milled enamel before it is delivered to the enamel shop has improved the final results.

Development of the heat-resisting enamels for exhaust systems, and low-temperature enamels for aluminum, show the wide range over which porcelain enamels might be made and at the same time allow them to maintain the advantage of abrasion, heat and corrosion resistance which no other finish possesses.

MACHINE *Editorial* DESIGN

Price Reductions Become Primary Aim

With wages and costs spiraling upward as they did last year, the recent reduction in the price of Ford cars came as a surprise to many. That it will prove to have been a step in the right direction, however, tending to initiate a steadying influence, is practically certain. It is all the more noteworthy because it came at a time when a reduction in price was not essential and consequently will have a greater effect on the buying public and on other manufacturers than would have been the case had the decrease been held off until forced upon the producer by lack of demand.

It is a foregone conclusion that current sales volume and backlog of orders for all types of manufactured goods cannot be expected to continue. Evidently Ford had this in mind in establishing lower prices and, if a stable economy is to be maintained, it is a factor that might well be taken into full consideration by other machine builders. That many already are doing so is proved by the fact that designers (as substantiated through a recent survey made by MACHINE DESIGN) are placing foremost emphasis on methods of reducing costs.

The compelling necessity for a continuance of high production extending into the future throws an even greater responsibity on the designer. It is essential that he consider the elimination of all "frills" in the development of his machine yet at the same time that he incorporate in it those refinements—particularly in the consumer goods field—which will arouse the urge to buy in the minds of potential purchasers. Designers also will be called upon to give the maximum of attention to developing their machines from the standpoint of economy in production—a feature that was relegated to the background during the war.

Although the thought of adopting economy as the primary factor in design conflicts with the ideas of machine builders in this country, consideration of all the current and potential conditions makes it highly desirable. Not alone is this the case from the viewpoint of continued high domestic sales and production, but also from the aspect of building up and maintaining international trade through sales to foreign markets. With Britain and Russia already putting forward every effort to capture these, little chance would remain for America to export its share of goods unless the opportunity for mass production is still further enhanced and maintained, and sound as well as economical design practiced to the fullest posible extent.

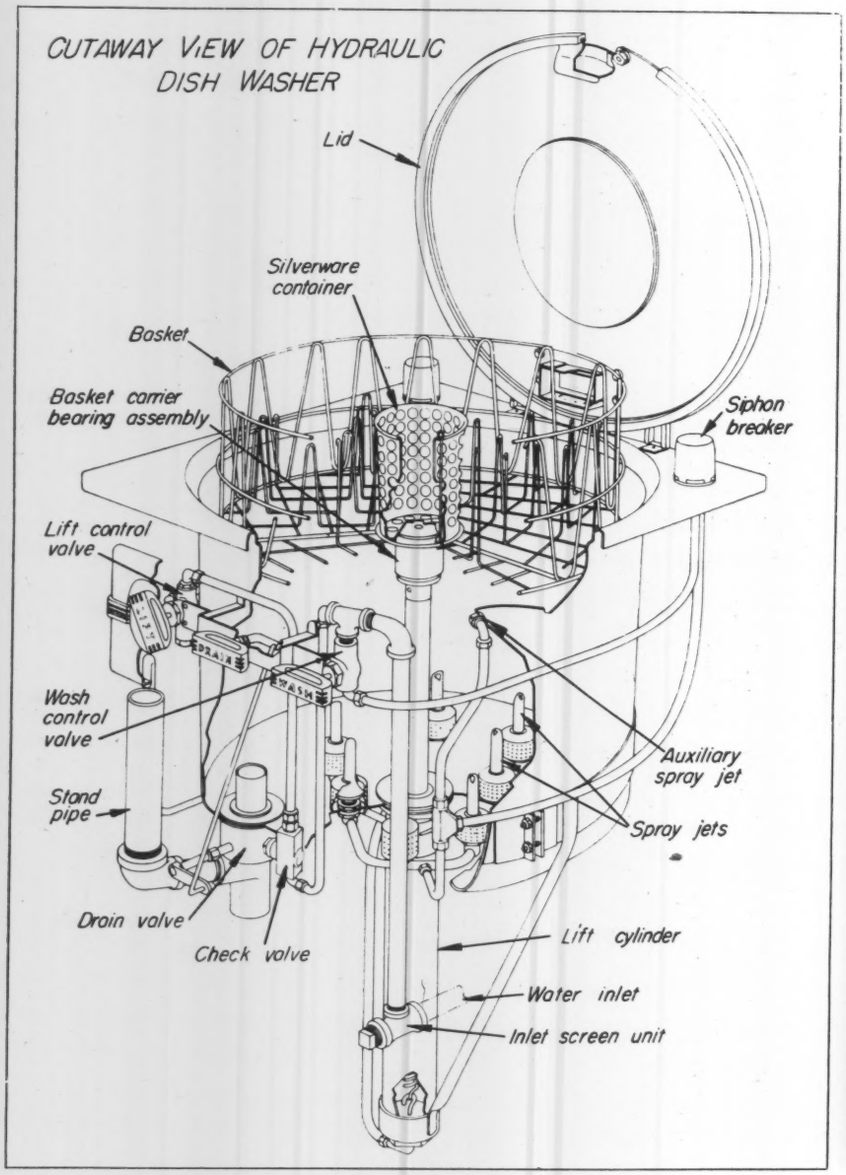
L. E. Jermy

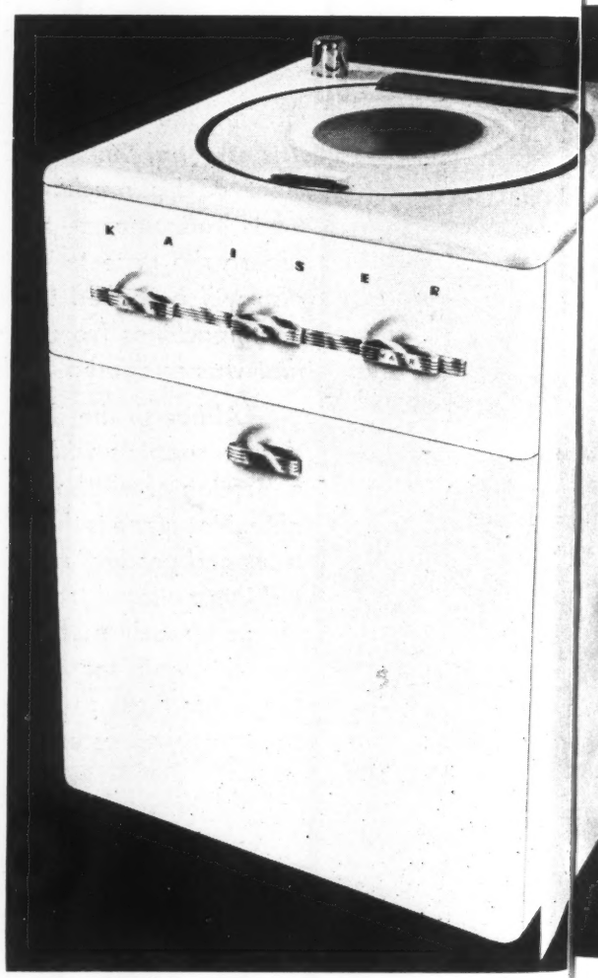
DESIGNS OF THE MONTH

Motorless Dish Washer

USING no motor or wiring, this novel home dish washer derives the power for whirling and raising its basket direct from the house hot water line. With the basket loaded and in its lower position, hot water is fed from the inlet pipe through a screen to a T-fitting, one outlet of which connects to the wash-control valve and the other through piping and a check valve to the lift-control valve. To initiate the washing cycle, the lift-control valve is turned off and the wash control valve is turned on. The hot water then is piped through a siphon breaker to the seven spray jets at the bottom of the basin and also to the auxiliary spray jet. Purpose of the siphon breaker is to check backflow during washing and draining.

Because of a venturi action designed into the spray jets, water in the basin is recirculated through the jets, the resultant volume of spray being considerably greater than the primary spray. Jets are directed so that force of the sprays





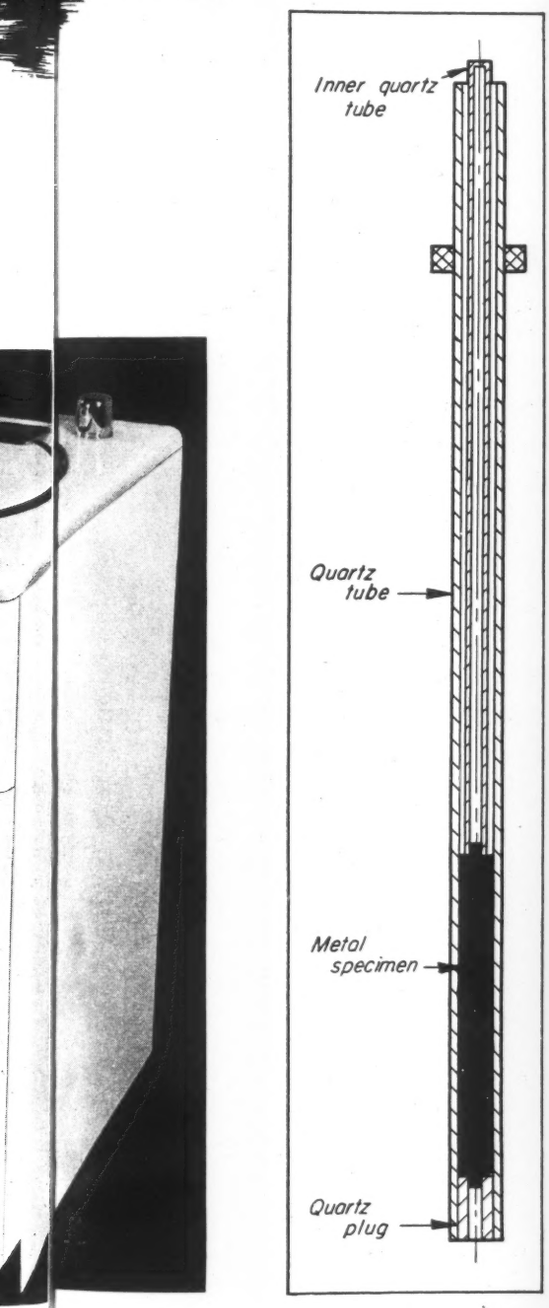
against the dishes whirls the basket. Removable screens around the jet bases are to prevent food particles from recirculating through the jets.

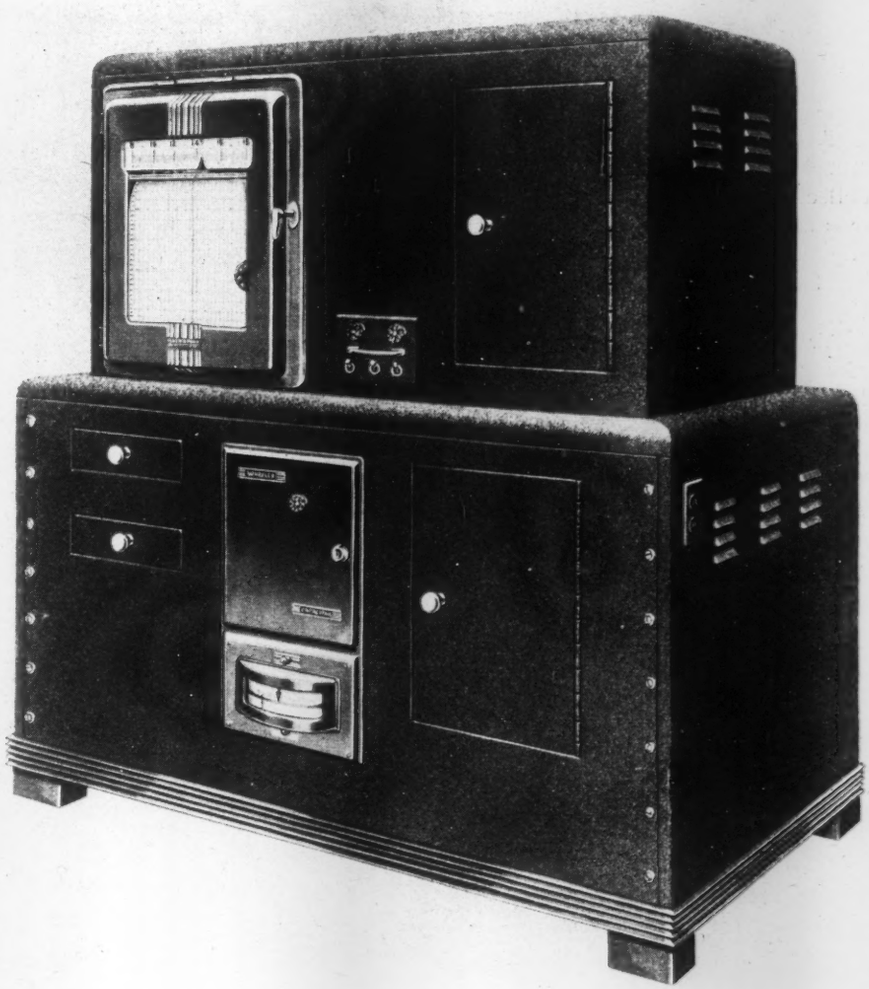
After dishes have been washed, the wash-control valve is turned off and the lift-control valve is turned on. Hot water then passes through the T-fitting at the top of the wash-control valve, through the check valve, through the lift-control valve, through a syphon breaker and into the bottom of the hydraulic lift cylinder the piston of which rises, lifting the basket with it out of the cabinet. The basket is mounted on a double-row, fully-enclosed ball bearing and continues whirling due to its momentum as it rises. This whirling action assists in drying the dishes.

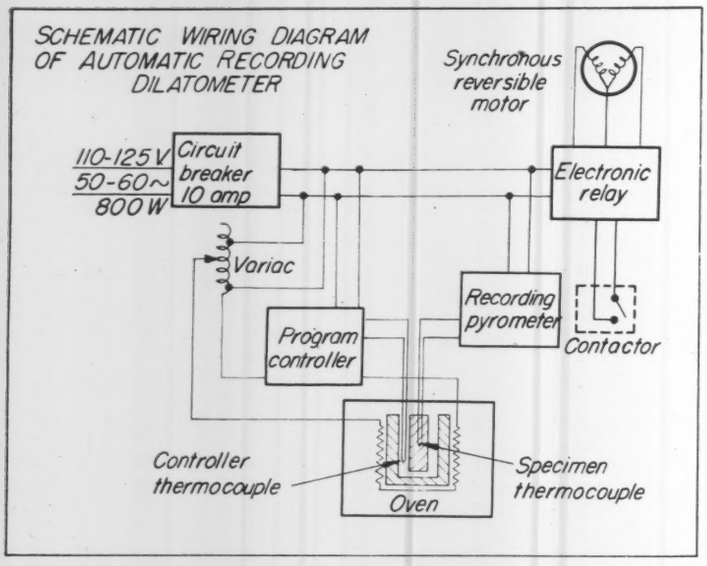
Washer basin is satin-surfaced aluminum and cabinet is aluminum, finished in white baked enamel. Fittings and controls are finished in polished chrome. Manufacturer: Kaiser Fleetwings, Inc., Bristol, Pa.

Continuous Recording Dilatometer

DESIGNED to provide continuous readings of the thermal expansion of metals, glasses, ceramics and plastics, this dilatometer is composed of six principal units: Furnace, program controller, specimen holder, recording pyrometer, a gearbox and support, and an electronic relay. The furnace, a stainless steel shell, is heated by nichrome wire helically wound on a grooved alundum tube around which is suitable insulating brick. Inside the alundum core is a long copper block with a hole running along its principal axis. A copper plug at the base of the block couples with







a copper tube which admits inert atmosphere to the specimen under test. Four smaller holes running lengthwise through the block are interconnected with copper tubing to conduct a stream of hydrogen for controlling cooling rate. Between the alundum core and the copper block is a thermocouple leading to a junction box on the furnace cover. A proportioning program controller is used to control the heating and cooling cycle of the furnace, as shown in the diagram.

Transmission of specimen expansion is made possible by using the concentric quartz tube principle. The outer concentric quartz tube, as will be seen in the cross section drawing, has sealed in its lower end a drilled quartz plug against which the bottom end of the specimen rests. The centering stud of the specimen fits loosely into a hole in the plug which also serves to admit the desired atmosphere around the specimen.

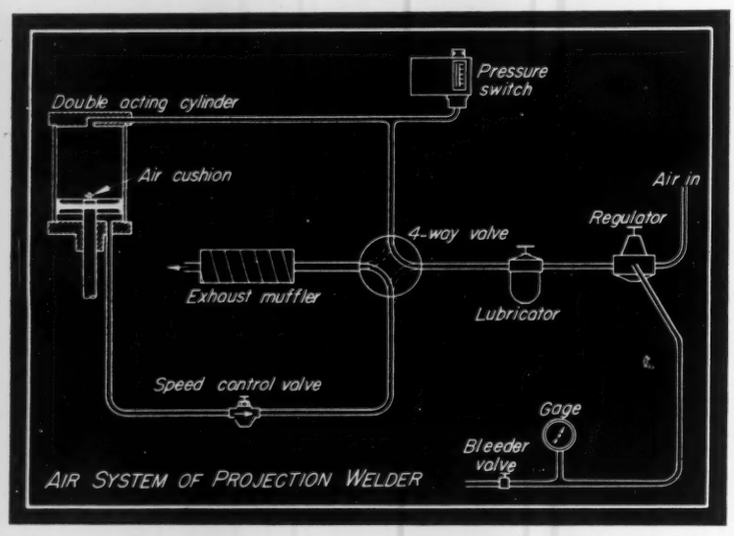
Face of the plug is ground optically flat as is the bottom face of the inner quartz tube which transmits movement due to expansion or contraction of the specimen to a dial gage. The inner tube is centered near the lower end by three small quartz spacers melted into the tube. These are spaced on the same horizontal plane and are oriented 120 degrees from each other. A hole running the entire length of the inner quartz tube serves to center the specimen by sliding it over the stud on the upper end of the specimen.

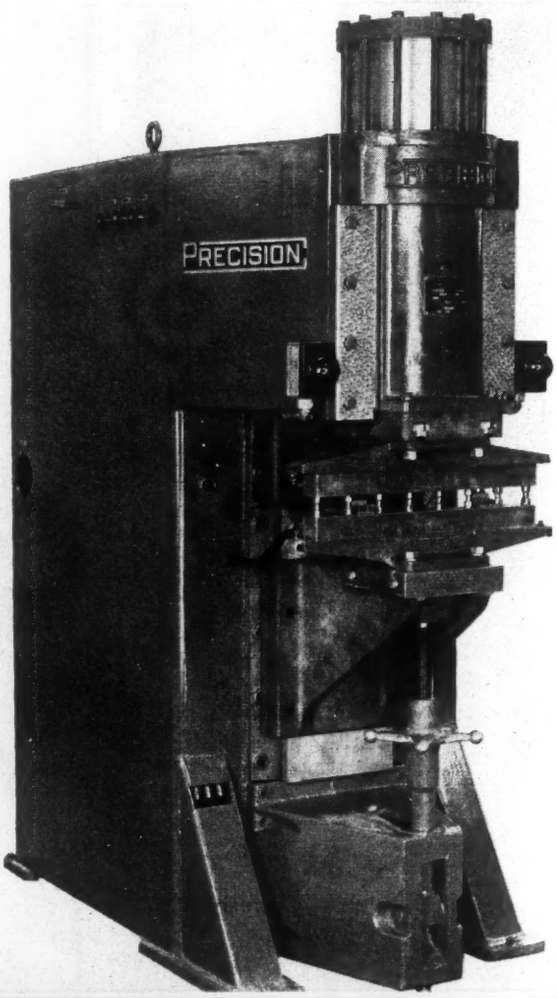
Upper end of the quartz tube is self centering when its countersunk surface comes in contact with the rounded end of the dial gage spindle shaft. Manufacturer: Sylvania Electric Products Inc., Electronic Div., New York.

Air-Powered, Water-Cooled Resistance Welding Press

ONE-PIECE construction of this projection welder's overhung arm and frame not only permits maximum rigidity and minimum deflection, but also provides for straight-line machining operations, thus assuring accuracy between the upper movable platen and the adjustable lower platen. Heavy design and rigid mounting of the face plate casting along with special machining of the lower knee also plays an important part in obtaining this accuracy.

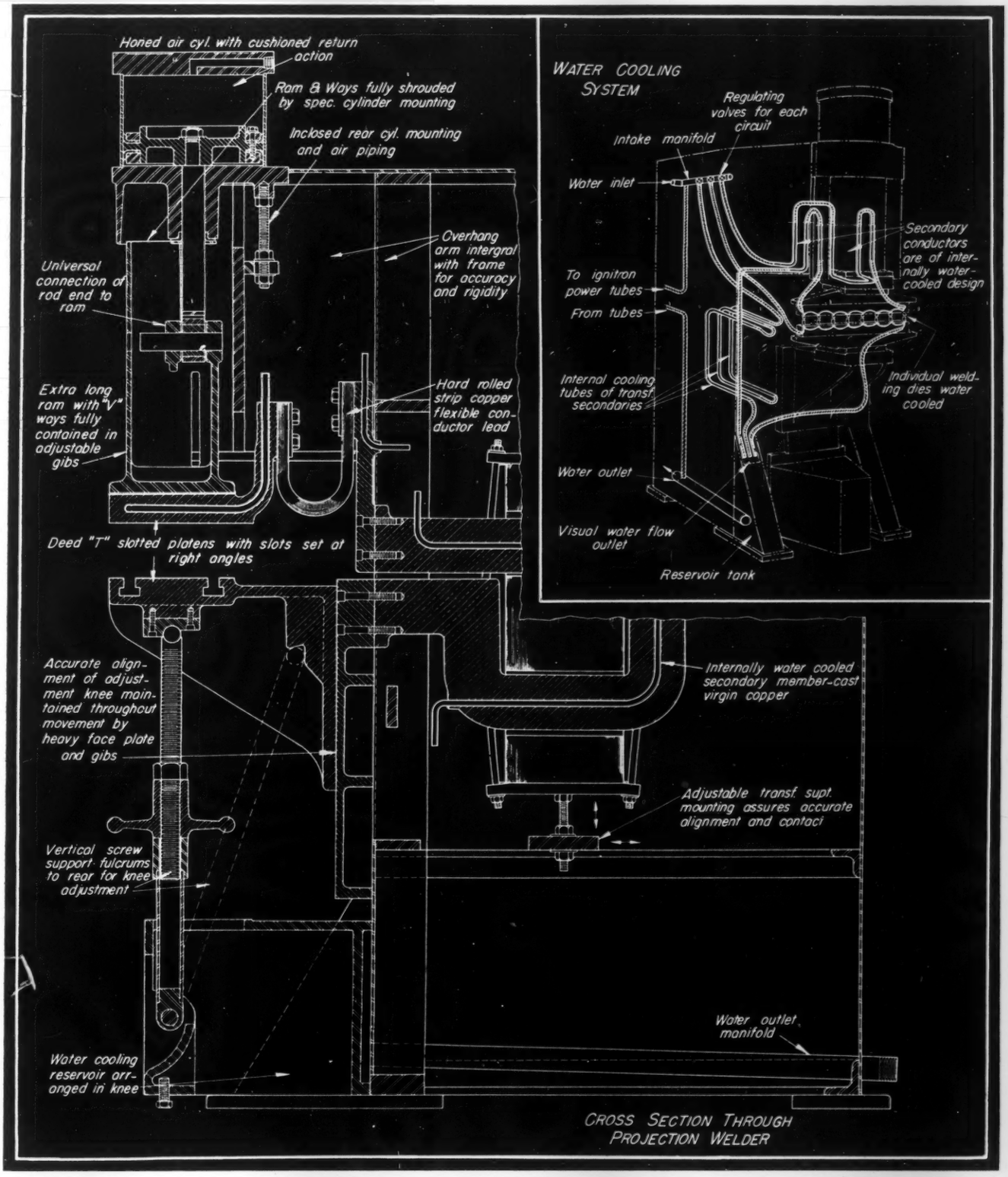
Air requirements of the welder are indicated in the schematic piping diagram, below. Here again the designers have not overlooked the advantages of close-coupled and unrestricted air flow





to and from the weld pressure cylinder. To minimize the set-up time in changing from one welding application to another, the air regulator, bleeder valve and gage are placed in the front panel of the machine within easy reach of the operator.

The outline drawing of the water cooling system shows the extent to which water is used in a welding machine. Arrangements are made for separate circuits to the ignitron power tubes, to the welding transformer, to the secondary conductors, and to the individual welding electrodes. It is absolutely necessary that all of the above members run cool throughout long periods of operation to insure maximum efficiency and to maintain consistent results in the welded product. Manufacturer: Precision Welder & Machine Co., Cincinnati.

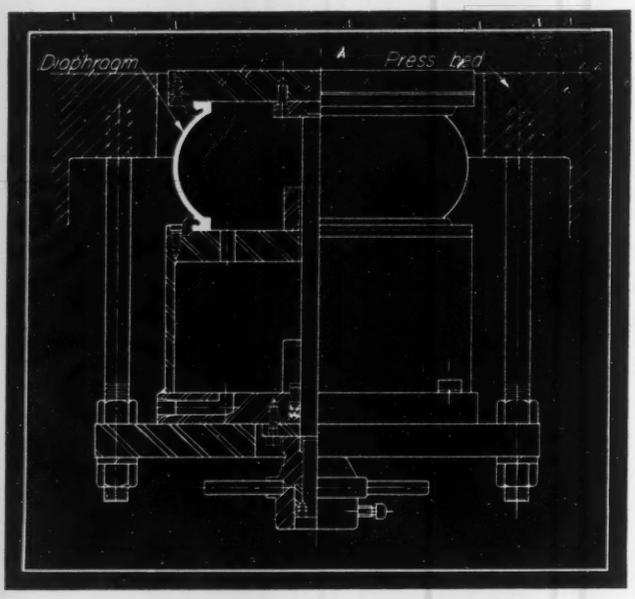


Applications

of engineering parts, materials and processes

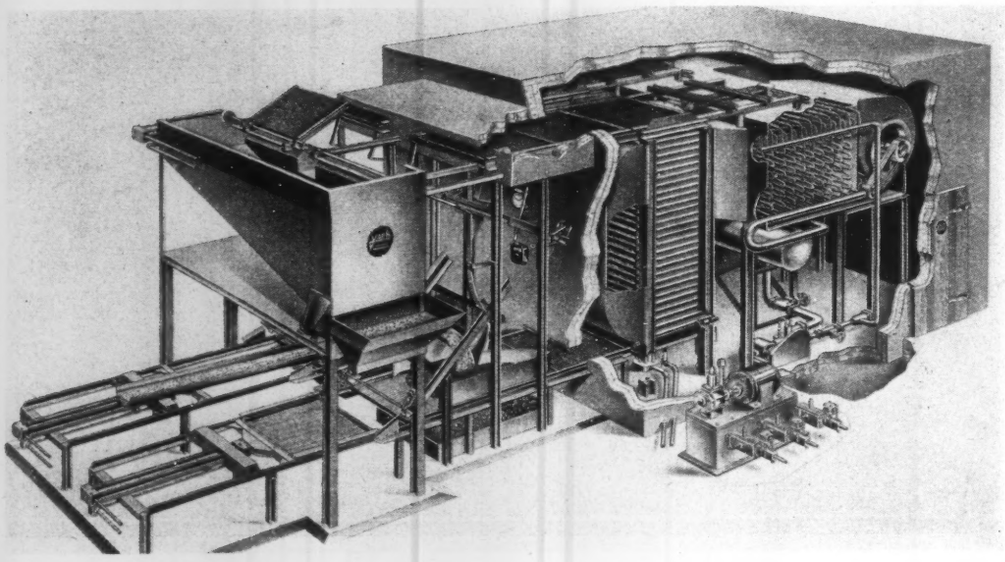
Die Cushion Utilizes Rubber Diaphragm

RESILIENCY and cushioning effect of the Dayton Rogers pneumatic die cushion are obtained through the use of an annular rubber diaphragm. The cushion, seen in the illustration below, is charged with a predetermined pressure of air. When loaded from above, the cushion deflects by further compressing the entrapped air. the rubber ring, seen as a solid white area in the illustration, shortens in height and increases in diameter to permit the deflection of the die.



Cylinders Solve Conveying Problem

ENTIRE feed of food-freezing trays in the York corporation's "Fast Freezer", below, is accomplished by hydraulic cylinders, making a simple trouble-proof system capable of withstanding continuous rough service. Food, such as berries and beans, is carried to the machine in a stream of water by the flume at the left in the illustration. Pouring down onto screen-bottom trays, the food is relieved of its conveying water. Horizontal cylinders force the trays to the right under a leveling plow and thence to the bottom of the cooling stack. Vertical cylinders controlled by timers then step the trays upward at a uniform rate. Rapid freezing is accomplished by refrigerated air passing horizontally between the trays. At the top of the stack another set of cylinders forces the trays out of the freezing compartment and onto the arms of the food dumping device, also cylinder actuated. This arrangement flops the trays upside down over a food hopper, breaking the frozen material loose. On return stroke, the tray motion is reversed. The arms swing the tray over to a ramp down which it slides to again receive food and repeat the cycle. Operation of the bulk freezer is entirely automatic, and the device is continuous in operation. Power is supplied to the various cylinders from a Racine hydraulic pump located outside of the cooling compartment.



Wichita City Libr

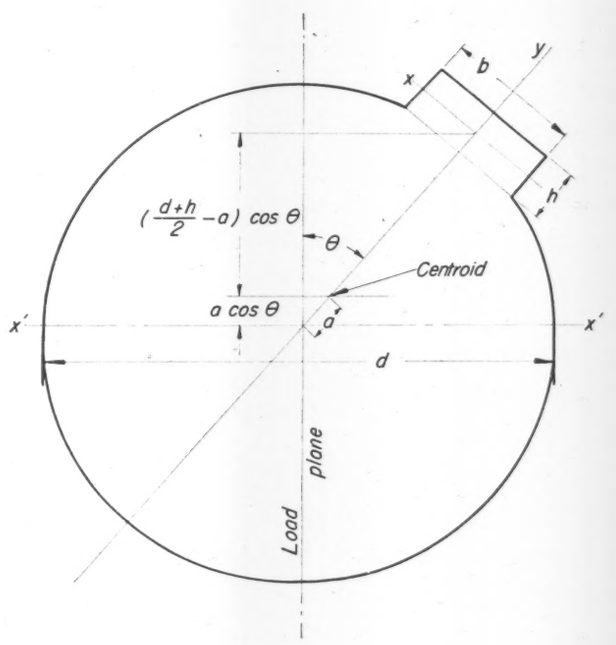
Bending Stiffness of Beams with Ribs or Slots

By R. L. Benford
Gear Engineering Div.
General Electric Co.
Schenectady, N. Y.

MANY modern applications of shafts, axles and housings are designed with keyways, splines or ribs and loaded as beams. To realize the full strength of such parts, the increase in stiffness due to ribs, or the decrease due to slots, must be calculated. An exact method, developed for circular sections but applicable to other symmetrical profiles, has been developed and is presented in this data sheet. Formulas are given for calculating the bending stiffness corrections for one or more ribs or slots on a round section.

To determine the additional stiffness of a rib accurately and to account for transverse loads not in the plane of the rib, the equations given in *Fig.* 1 should be used. The term I_x' represents the increment to be added to the moment of inertia of the shaft. The same expression applies to a slot, the increment I_x' being subtracted instead of added. The minimum resistance to bending will occur when the direction of loading and the keyway are in the

Fig. 1—Formulas relating to the amount of inertia correction for a rib or slot rib on a round shaft. Term I_x' is added for a rib, subtracted for a slot



$A=bh$

$a=\frac{1}{2}\frac{A(d+h)}{A+\frac{1}{4}\pi d^2}$

$i_x=bh^3/12$

$i_y=b^3h/12$

$r^2=\frac{1}{4}(d+h)^2$ for rib

$r^2=\frac{1}{4}(d-h)^2$ for slot

$$I_x'=i_x\cos^2\theta+A(r-a)^2\cos^2\theta+i_y\sin^2\theta+\tfrac{1}{4}(ad\cos\theta)^2$$

same plane, the maximum resistance when these two are at right angles.

For two identical ribs or slots at 180 degrees, a similar correction must be applied. Here, however, the centroid is not displaced ($a=0$) and the neutral axis crosses the section centerline, thus simplifying the calculation. There remains, however, an angular function in the expression for bending stiffness, as shown when two slots are considered and a is set equal to zero in the equation on *Fig.* 1:

$$I_x' = 2(i_x + Ar^2)\cos^2\theta + 2i_y \sin^2\theta$$

In deriving the bending stiffness for a round beam with three identical, equally spaced ribs, the angular function drops out. This means that the round beam (shaft, pipe, tube) with three regularly spaced equal ribs has the same

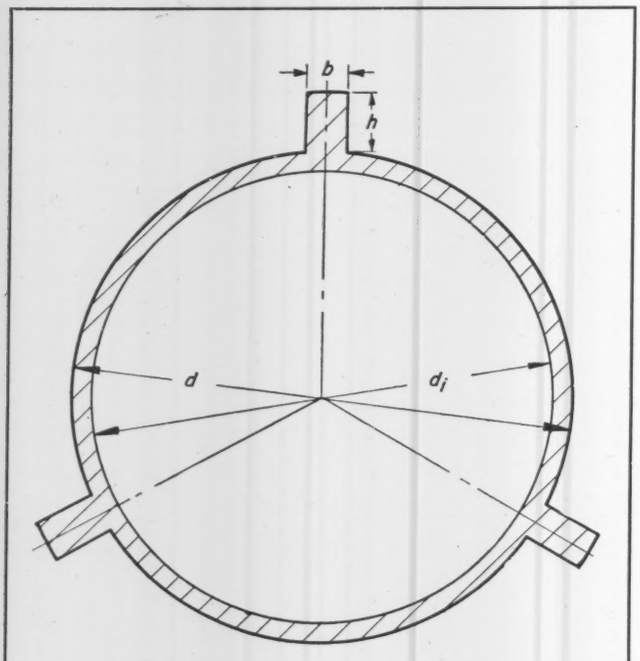


Fig. 2—Formula for moment of inertia of a hollow sleeve stiffened by three identical equally spaced ribs

strength in any transverse direction. The stiffness expression assumes an easily remembered form, which is given in *Fig.* 2. In this equation the first term is the moment of inertia of the round section. The second and third terms are the principal moments of inertia of the rectangular section, taken through the section centroid at right angles to one another. The fourth term is the familiar Ad^2 step for transposing the axis of rotation from the section centroid to some other point. Note that these three terms are each multiplied by 1.5, which is half the number of ribs.

Four ribs or slots, five ribs or slots, or any number of

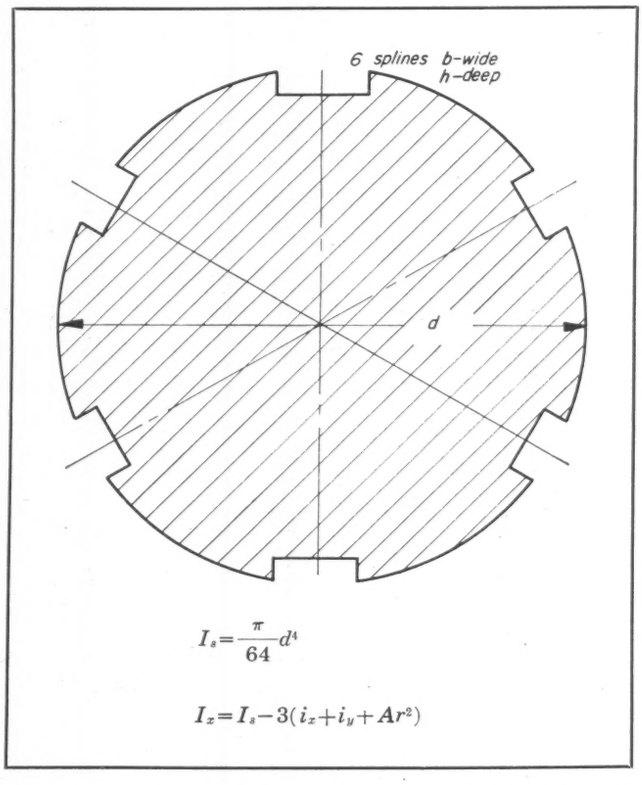


Fig. 3—Formula for moment of inertia of a solid shaft having six splines

ribs or slots greater than two will cause equal stiffness in all transverse directions, assuming each rib or slot is identical and regularly spaced. In each case, the incremental amount of stiffness for the round section is found by adding the two principal moments of inertia to the Ad^2 term, and multiplying the sum by half the number of ribs. Thus, for N ribs

$$I_x' = \frac{N}{2}(i_x + i_y + Ar^2)$$

Application to a splined shaft with six slots is shown in *Fig.* 3.

For an exact solution, the quantity $b^3d/16$ should be subtracted once for each rib in the foregoing formulas. This correction considers the small area included between the base of a rectangular rib and the arc of the circle. For a slot the correction should of course be added.

Assets to a Bookcase

Modern Organic Finishes

By Rollin H. Wampler, technical director, Southern Varnish Corp., published by the Chemical Publishing Co., Brooklyn, New York; 445 pages, 5¾ by 8¾ inches, clothbound; available through MACHINE DESIGN, *$8.50 postpaid.*

Surfaces of machine parts not designed for sliding contact are commonly covered with a protective coating of the oxidizing or volatile vehicle type. Such finishes are represented by enamels, lacquers, and synthetic coatings. It is with these types of finishes that the author deals in a discussion of materials, applications and finishing processes.

Under the heading of materials are discussed varnishes, lacquers and stains, and their chemical and physical properties. Modifying agents, and pigmentation are discussed in some detail. The balance of the book is devoted to methods of application, covering spraying, dipping and other representative methods.

If organic finishes are considered to be divided into two divisions—high-strength wear-resisting coatings, and moderate-strength decorative coatings—this book is without doubt a treatment of the latter group. So pointed, the volume is undoubtedly of great value to the preponderance of those in the design field. However, such data as wearing properties, corrosion resistance, and chemical resistance have been omitted, reducing to a degree the value of the information actually included.

□ □ □

Mechanical Measurements by Electrical Methods

By Howard G. Roberts, special research associate professor, Engineering Experimenting Station, University of Illinois; published by the Instruments Publishing Co. Inc., Pittsburgh; 357 pages, 4¾ by 8¼ inches, clothbound; available through MACHINE DESIGN, *$3.00 postpaid.*

In the broad field of measurements, it is a unique fact that this one book covers the subdivision of electrical gaging. Despite the fact that the electrical technique of measurement is almost consistently simpler and easier than the mechanical, information concerning the technique has been scanty and broadcast over a wide range of publications. This summary and consolidation of information on the subject is timely, appropriate and should be of outstanding value and importance to the engineering profession.

The book has been divided into two distinct parts. Part I discusses principles of the apparatus, their electrical circuits, characteristics and applications. It is well illustrated with photographs and line drawings and a considerable number of references cover much of the published material referred to above. Part II, concerning equipment, discusses the technique and application of electrical measurements and the types of equipment employed.

In eighteen chapters the author covers gaging methods by variations of capacitance, inductance, and resistance. Also discussed are such gaging methods as photoelectric, piezoelectric, thermoelectric, and acoustics and considerable information is given on bridge and potentiometer circuits and electronic auxiliary apparatus.

□ □ □

The Technique of Executive Control

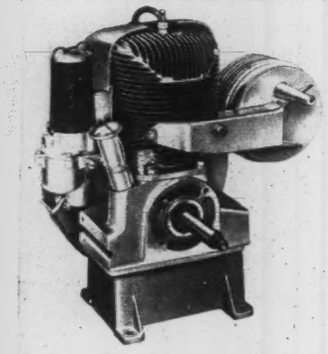
By Erwin H. Schell, professor of business management, Massachusetts Institute of Technology; published by the McGraw-Hill Book Co., New York; 270 pages, 5 by 7½ inches, clothbound; available through MACHINE DESIGN, *$2.25 postpaid.*

More is demanded of the engineering executive these days than at any time in recent history, and it is imperative that the proper action shall be forthcoming at the proper time. Making a constructive analysis of executive conduct, this book supplies a guide by which the executive may measure his actions against the recommended. It offers an analysis of problems confronting the executive in his relations with equal, subordinate and superior working associates, and suggests the correct methods of handling the problems and the system of analysis to be used. Covered are such subjects as: Attitude, control, duties, difficulties and proficiency. It is a valuable, handy little book which may well be a touchstone to the engineer uncertain of the correctness of his actions in handling people.

A drafting manual for use by those concerned with the design of aircraft or aircraft parts has been released by the Society of Automotive Engineers. This manual, meeting a long-felt need, was compiled by 17 leading aeronautical engineers after more than a year of work. It should be emphasized, however, that the book represents present actual practice in the industry rather than new improved standards. It covers in brief pictorial form the subjects of: Abbreviations, dimensioning, screw threads, finishes, forgings, and splines. The manual will be kept up to date by the SAE Aeronautical Drafting Committee, which will continue to make revisions in accordance with changes in the manufacturing art. Measuring 8½ by 11 inches loose-leaf bound, the volume is available from the Society of Automotive Engineers, Inc., 29 W. 39th St., New York 18, in two forms: Leatherette binding at $4.50, and unbound volumes at $2.50.

new parts and materials

Gasoline Engines



LINE OF small, lightweight, 2-cycle gasoline engines has been introduced by McCulloch Motors Corp., 6101 West Century Blvd., Los Angeles 45, Calif. The models range from 2 1/2 to 4 hp and are designated Series 1200. Advantages claimed for the new line of engines are: Light weight, superior starting and idling characteristics, compact size, simplicity and adaptability for additional applications. Light weight is achieved by the wide use of aluminum-alloy die castings. All major parts of the engine, with exception of rods, crankshafts and cylinder sleeves, are high-pressure aluminum-alloy die castings. Oil injection system obviates mixing lubricant with gasoline.

Contact Tape

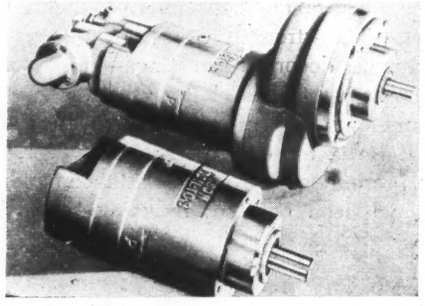
COMPLETE ASSEMBLIES of contact arms with tape attached are now being marketed by the D. E. Makepeace Co., Attleboro, Mass. The bar contact tapes are available in such metals as palladium alloys and silver. The tape itself may be bimetallic, using any of the precious metals or their alloys welded as a top to a nonferrous metal or alloy base.

Hydraulic Coupling

NOW AVAILABLE from the Twin Disc Clutch Co., Rockford, Ill., a new series of small hydraulic couplings is designed for use with induction motors and small internal combustion engines. The six couplings in the series have various ratings ranging from 1 to 25 hp at 1800 rpm and supplement the widely used line of Twin Disc hydraulic couplings for larger applications. They assure smooth acceleration, prevent stalling, allow the engine or motor to be fitted to actual running requirements and eliminate the need for shear pins and similar break and replace protections for driven parts. The couplings distribute the load on multiple-engine or motor drives, permit the reversing of electric motors at full-load speed without high current surges and, in the case of a standard motor, permit motor to start under no load and thus make high torque available for starting. Typical application is Link-Belt Electrofluid Drive.

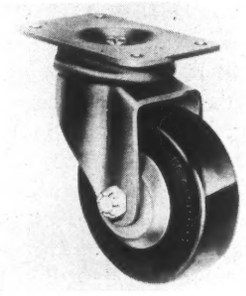
Hydraulic Motor

HYDRAULIC motor of axial-piston design is now available in 3 and 5 hp capacities, with or without speed-control valves. The new fluid motor may be obtained with gear-head units of various gear ratios and with a number of mounting-bracket styles. The plunger device interlocking with the speed-control valve permits instant acceleration from any preset speed to full speed whenever



desired. When plunger is released, the motor returns at once to its preset speed. Manufacturer is the Denison Engineering Co., Columbus 16, Ohio.

New Castor



PLACED on the market by the Rapids-Standard Co. Inc., Dept. CA-53, 308 Peoples National Bank Bldg., Grand Rapids 2, Mich., a new caster named the Scout is the first of the No. 33 series of formed steel casters designed for light and medium duty service. The new caster is said to incorporate great liveliness in action and is recommended for use on all types of light trucks and dollies, and many types of portable equipment. A double ball race assembly of ample size provides free-swiveling action under rated load capacities and in a wide range of operating conditions and applications. Having load ratings varying

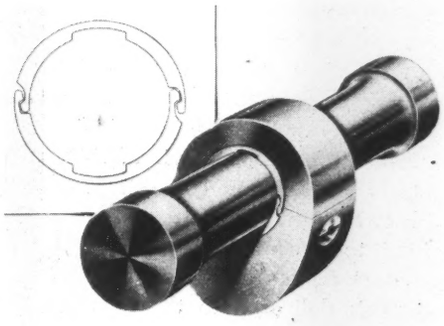
from 125 to 250 lb, the caster is manufactured in swivel and rigid models and may be equipped with either hard or soft tread, molded-rubber 3 1/2-inch diameter wheels.

Pillow Block

SELF-ALIGNING roller-bearing split pillow blocks are now being manufactured by the Shafer Bearing Corp., 1412 W. Washington Blvd., Chicago 7. New features of the design permit quick and easy installation, removal and replacement of the shaft without misalignment. Positive alignment dowel bolts provide quick, sure alignment of cap, bearing and base. No separate dowels are needed. A lubricant reservoir served by a single conveniently located filler hole assures adequate lubrication.

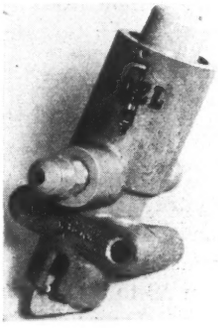
Retaining Rings

TWO-part interlocking retaining ring forming a complete annular shoulder of uniform section height has been announced by Waldes Kohinoor, Inc., Long Island City 1, N. Y. Identified as the Truarc interlocking ring type 5107, the unit is said to eliminate the wide-gap characteristic typical of conventional open type C-rings, which substantially reduces normal thrust capacity of the ring. The ring is of dynamically balanced design and therefore suitable for equipment involving high rotational speeds. Because of positive interlocking action the ring cannot



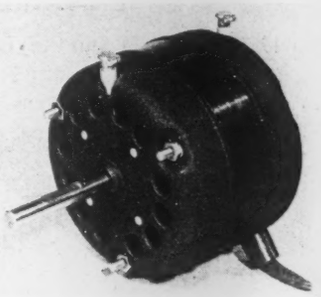
be lifted out of its groove by high centrifugal forces or by linear expansion caused by friction. Disassembly of the ring requires only slight prying action with screw driver.

Hydraulic Lock



INTENDED for use in conjunction with hydraulic systems in which a mechanical lock is needed to securely hold mechanisms in a given position, a new mechanism lock has recently been brought out by Adel Precision Products Corp., 10777 Van Owen St., Burbank, Calif. Placed in a circuit in series with a hydraulic actuating cylinder or a radial hydraulic actuator, the lock must unlatch before fluid pressure can operate the actuating device. The latch is spring-loaded in the direction of automatic operation, and the function is such as to release against the compression spring on 50 psi minimum fluid pressure in the opposite or unlatching direction. Total latch movement is 0.375-inch. The units may be assembled to provide right or left-hand lock mounting assemblies, and weigh 0.38-lb.

Fractional-Horsepower Motor

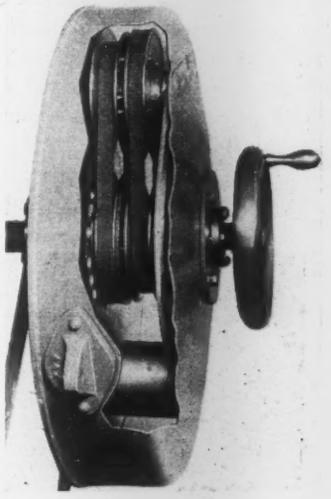


SHADED-POLE motor of a new design has recently been brought out by the Alliance Mfg. Co., Alliance, Ohio. The new motor, which operates on 220 volts, 60 cycle current, is of the air-cooled type delivering up to 40 oz-in. of torque at 1000 rpm. The motor is of 6-pole shaded design with a top rating of approximately 1/30-hp. It measures 4 1/2 inches outside diameter and has an overall length from 2 3/4 inches to approximately 4 5/8 inches depending on rating required.

Ball-Bearing Turntable

PLACED on the market by the Whiting Corp., Harvey, Ill., is a line of sturdy turntables ranging from 42 to 96 inches in diameter. The turntables are carried on hardened steel balls running in a specially machined ball-race to permit wide distribution of load and easy operation. A quick acting, foot-operated release lock at table-top level holds table securely in position.

Variable Speed Drive

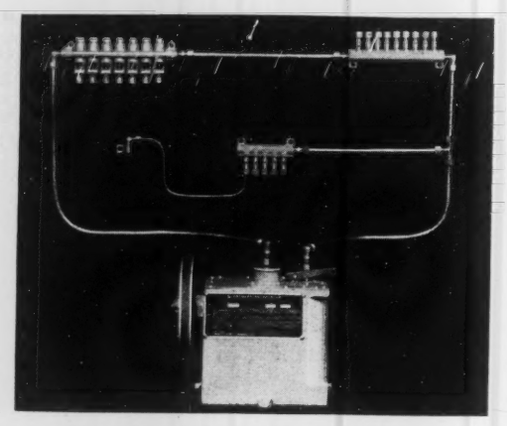


CONSTANT-TORQUE variable-speed drive, providing infinite ratios from full speed forward through zero to full speed reverse, has been announced by Speed Selector Inc., 118 Noble Court, Cleveland 13 and B. F. Goodrich Co., Akron, Ohio. (See MACHINE DESIGN, November '46, page 107). The unit which is known as the Variable-V-Planetary Speed Selector, utilizes planetary motion by mechanically adding or subtracting speed produced by four variable pitch pulleys driven by two V-belts. Speeds are thus obtainable from zero to 400 rpm, clockwise and counterclockwise. Changes are made by a hand control wheel, varying the pitch diameter of

the center pulleys, so that as one is increased the other is decreased and the change imparted to the outer pulleys by the wedging action of the V-belts. Hand wheel is mounted on the input shaft of the driven machine by a tapered collet and controls diameter of all four pulleys without use of springs or complex linkages. Applications for the unit include: Agitators, conveyors, grinders, hoists, lathes, etc.

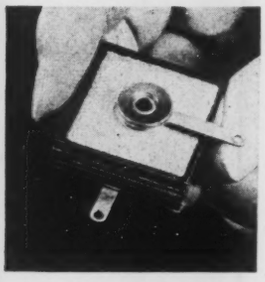
Lubricating System

DEVELOPED by the Lubrication Division of Rivett Lathe & Grinder, Inc., Brighton, Mass., is a pressure type of lubricating system known as Pulsolator, incorporating and improved pressure type "window" feeder. Through this window the flow of oil and action of the needle valve may be watched at all times and the valve adjusted to the needs of the bearing. The Pulsolator system may be built as an integral part of a new machine



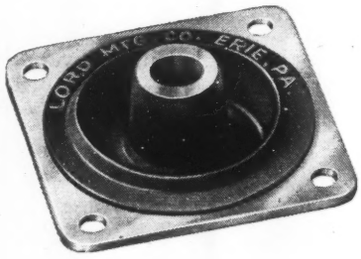
and consists of a central pumping unit with a reservoir, an oil-supply line which runs from and returns to the pumping unit, and metering feeders mounted along the oil-supply line in proximity to their respective bearings. Standard pumping units with reservoir capacities from one quart to fifty-five gallons are capable of lubricating from one to four-hundred individual bearings, while special pumping units are engineered to fit peculiarities of any installation.

Selenium Rectifier



REPLACING many rectifier-type tubes now used in amplifiers and radios, a new midget-size selenium rectifier developed by the Federal Telephone and Radio Corp., Newark, N. J., consists of five square selenium plates on aluminum base plates connected in series. The unit, known as Type 403D-2625, measures 1¼ inches square by 11/16 inches high. Life of the rectifier is said to be many times that of tubes for the same purpose. The unit has a rated current carrying capacity of 100 milliamperes dc and a peak inverse voltage of 330 volts. Installed in pairs as voltage doublers with condenser values up to 40 μf, the use of a transformer, rectifier tubes and sockets is eliminated.

Vibration Mount



VIBRATION mount known as "Multiplane" now being manufactured by Lord Mfg. Co., Erie, Pa., is claimed to isolate vibration regardless of the direction of the disturbing forces. The new mounting is recommended by the manufacturer especially for protection of equipment exposed to vibration of indeterminate nature. It is stated that successful applications have already been made on instrument panels, electronic equipment, fans, blowers, etc. The principle of rubber-in-shear has been utilized in these mounts to secure equal softness in all places.

Resonant Relay

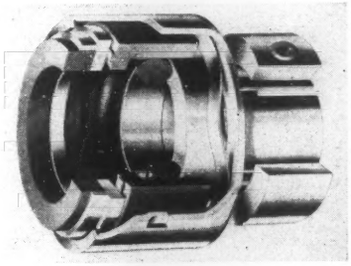
BASED on a vibrating-reed mechanism adjusted to respond to a narrow band of frequencies and to reject all others, a new relay known as type 182 responds to signals over existing circuits. A small amount of energy received by the relay at its resonant frequency causes the contacts to vibrate. These contacts in turn, are connected in series between the power supply and the circuit to be controlled. When the relay operates, current from the power supply is delivered to the circuit to be controlled at the resonant frequency of the relay. Whenever a control frequency is sent by wire or radio to a remote location, the resonant relay at that point will accept the control frequency and reject all others. Only a small amount of energy is required to operate the resonant relay at that point and by connecting an auxiliary relay or a Thyratron to the resonant relay almost any switching operation may be accomplished at the remote location. The relay is manufactured by Stevens Arnold Co. Inc., 22 Elkins Street, South Boston, Mass.

Centrifugal Pumps

NOW BEING MADE by the Allis-Chalmers Mfg. Co., Milwaukee, Wis., a new line of centrifugal pumps is designed for pedestal-mounting. The cast-iron bronze-fitted pumps are available in three principal sizes: One, two and three inch with capacities from 10 to 500 gallons per minute at heads from 10 to 100 feet. Power requirements range from ¼ to 15 hp. The pumps are designed

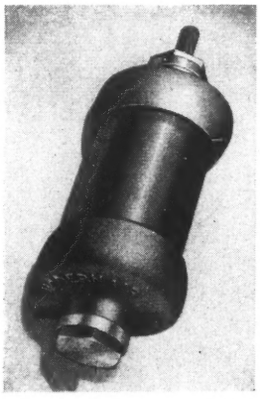
for use with Texrope V-belt drives giving an infinite range of capacities regulated by size of sheaves and power supplied. All the pumps are supplied with impellers of maximum diameter, and variations in capacity are provided by changes in speed through sheaves of larger and smaller diameter. The units are small and compactly designed and will operate in any position making them well suited to use on diesels, machine tools, air conditioners, etc.

Mechanical Seals



HEAVY rolled-type seal, designed for installation on a shaft outside of machine, has been announced by the Sealol Corp., 45 Willard Ave., Providence 5, R. I. The unit is packaged as a complete seal, wholly assembled without any loose parts. It slides into position on shaft and is locked in place with two setscrews. The only requirement for successful operation is a smooth, stationary surface for the seal to bear against and a straight shaft. The unit is available in noncorrosive construction for shaft sizes from 1/2 to 1 inch.

Pneumatic Cylinders



DEVELOPED BY the Modernair Corp., 4222 Hollis St., Oakland 8, Calif., is a new line of noncushion type air cylinders. The units have threaded cylinder caps sand cast of aluminum alloy and heat treated, thus eliminating tie rods. The caps may be rotated a full 360 degrees on the cylinder without affecting permanence of the seal, greatly simplifying installation of the unit. The cylinders, available in the range of 2, 2½, 3 and 4-inch diameters, have optional stroke lengths.

Blind Rivet

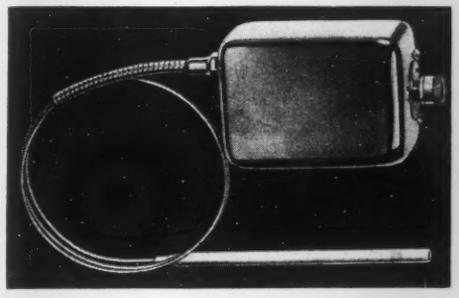
CHERRY BLIND RIVETS are now available in Monel as well as aluminum, brass and steel from the Cherry Rivet Co., 231 Winston St., Los Angeles 13. The new monel rivet is identical in construction with rivets of other material and is made in two standard types—self-plugging and pull-through hollow. It is available in 1/8, 5/32, 3/16, 1/4, and 9/32-inch diameters and in a wide range of grip lengths. Two standard head styles available are modified brazier and 100-degree countersunk.

Cellular Rubber

LIGHTER-THAN-CORK rubber for insulating purposes has been announced by the United States Rubber Co., Rockefeller Center, N. Y. The material, known as cellular rubber, can be made in hard or soft forms and is said to be effective as an insulator. It is nonmoisture absorbing as well as fire, acid, oil, and vermin resistant. The material is made by an expanding process in which chemicals containing nitrogen are mixed into a mass of rubber. Nitrogen on release acts as a blowing agent, producing thousands of microscopic cells.

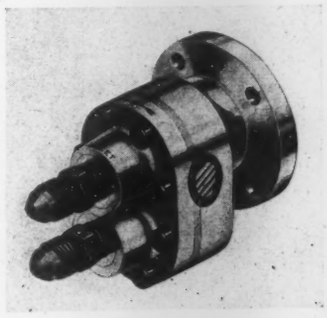
Industrial Thermostat

REMOTE-BULB type thermostat known as Type O, usable with all liquids or gases non-injurious to brass, or for metal-to-metal applications, is available from the United Electric Controls Co., 69 A St., Boston 27. Control is based on snap-action switch actuated by a liquid-filled copper thermal assembly. Units are said to have an unvarying and rapid expansion and contraction per degree of



temperature change and are adjustable by either knob and pointer with calibrated dial or by screw driver. The calibrated adjustments cover any 120 F or 250 F range from minus 120 to 600 F. Screw driver adjustments cover entire range from minus 120 F to 180 F, from 50 F to 350 F, or from 50 F to 600 F. Four bulb types, designed to provide most efficient operation for the particular installation, are available.

Hydraulic Lubrication Pump



ADDITION to the series of pumps manufactured by the McIntyre Co., 15 Riverdale Ave., Newton 58, Mass., is the new Series 1200 hydraulic pressure lubrication pump. The new unit is designed for pressure bearing lubrication of machine tools, diesel engines, turbines, generators and other high-speed heavy machinery, as well as for fluid handling in aircraft at high altitudes. This direct-drive gear pump is a small lightweight unit operating with a volumetric effi-

ciency of 95 per cent. Three standard models displace from 0.08 gpm to 1.5 gpm at speeds ranging from 1140 rpm to 3450 rpm against pressures up to 150 psi. Standard models are designed for direct motor application but can be furnished for other special mountings. Weighing 8 ounces, the unit has a power demand from 1/100 to 1/6 hp.

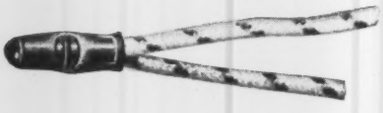
Solenoid Valve

DESIGNED for small-capacity installation involving the use of Freon, methyl chloride, water, air, oil, etc., a new valve has been placed on the market by the Henry Valve Co., 3260 W. Grand Ave., Chicago 51. The valve is

incorporated in a standard outlet box and can be mounted quickly through screw holes provided. The unit which is known as Type SV-11 is furnished with 3/8-inch fine pipe thread connections, requires 115 or 230 volts power supply.

Solderless Connector

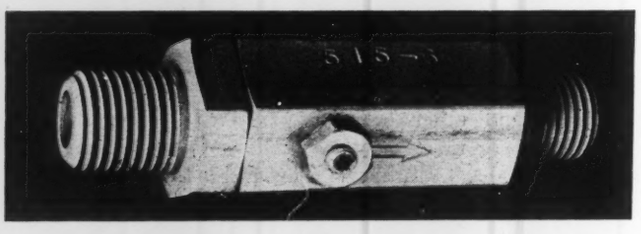
PIGTAIL splices that do not loosen under conditions of continuous vibration such as encountered in motors, etc., are now made by American Marine Products Inc. The connector is a plastic closed-end unit which makes a per-



manent, insulated splice with a single operation of an assembly tool. Soldering, wire twisting or taping is thus obviated. The manufacturer's address is 1591-0 North Fourth St., Harrisburg, Pa.

Speed-Control Valve

SPEED-CONTROL valve incorporating a new metering device is now being manufactured by Electrol, Incorporated, Kingston, N. Y. This addition to the line of Elec-



trol hydraulic devices allows free flow in one direction and controls precisely hydraulic flow in the opposite direction by means of a metering pin. Rate of flow can be adjusted to suit individual installation by the adjustment of a screw-actuated metering pin set in one of the hexagonal sides of the valve. The unit is compact in shape and can be used with pressures up to 1500 psi. It can handle air, oil and water. Standard valves are available in NPT port sizes at 1/8, 1/4, 3/8 and 1/2-inch.

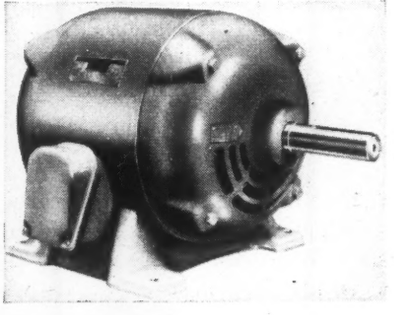
Ventilating Hose

LIGHTWEIGHT spiral-wire reinfoirced hoses manufactured by a new method have been announced by the American Ventilating Hose Co., 15 Park Row, New York 7. The hose made of neoprene pre-coated fabrics, has been designated as manufactured by the "continuous wind" process to differentiate between it and other manufacturing methods. Available in any length in diameters from 1 to 24 inches, the hose may be manufactured to

secure various degrees of flexibility, compressibility, crushing resistance and other physical characteristics. Various types of adapters can be permanently attached to any of these hose lengths if required, thus facilitating connection to many types of industrial equipment having outlets of different sizes or shapes.

Induction Motor

ALL-STEEL construction of new squirrel-cage induction motors makes possible a 35 per cent reduction in size without sacrifice of electrical properties. In addi-



tion, the motors are said to be lighter, more rigid and capable of withstanding greater impact than models hitherto available. The Westinghouse Electric Corp. series is known as "Life-Line" and is available in drip-

QUICK DELIVERY

on Cast Bronze Bearings

Here is Good News for manufacturers of all types of equipment. Now you can secure all your requirements in cast bronze bearings . . . particularly in the larger sizes . . . *in days* . . . not months. Our new and enlarged facilities plus over five hundred skilled, returned servicemen have made this excellent delivery possible.

On standard stock items . . . UNIVERSAL Bronze Bars, G. P. Bearings, Electric Motor Bearings . . . we can ship your order the day it is received.

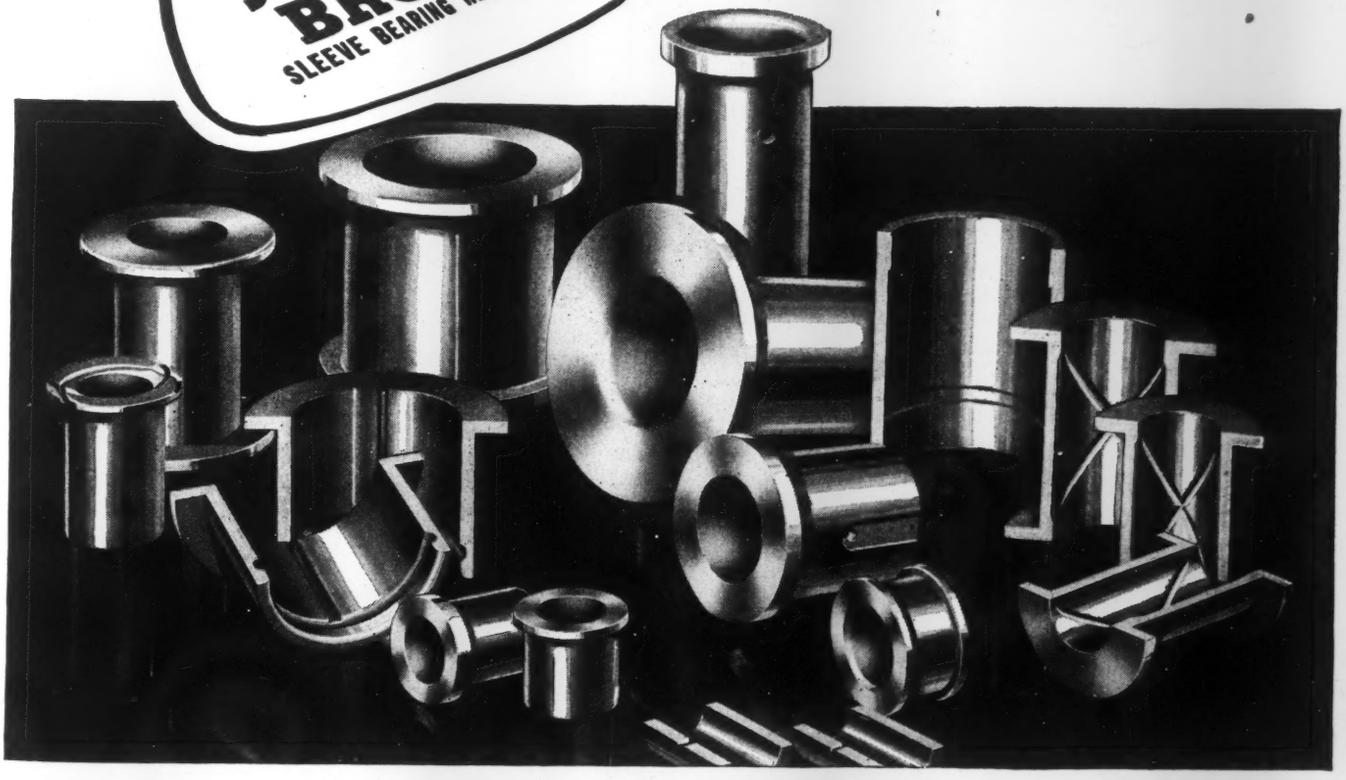
Why not check your requirements NOW? Send us your prints and your specifications. Remember, Johnson Bronze makes every type of Sleeve Bearing . . . an unfailing source of supply with the highest reputation for quality. Write, wire or call—TODAY.

Call **JOHNSON BRONZE**

at Atlanta • Cambridge, Mass. • Buffalo • Chicago • Cincinnati • Cleveland • Dallas • Detroit • Kansas City, Mo. • Los Angeles • Minneapolis • New York • Newark • Philadelphia • Pittsburgh • St. Louis • San Francisco • Seattle.

JOHNSON BRONZE COMPANY
525 South Mill Street **New Castle, Pa.**

JOHNSON BRONZE
SLEEVE BEARING HEADQUARTERS



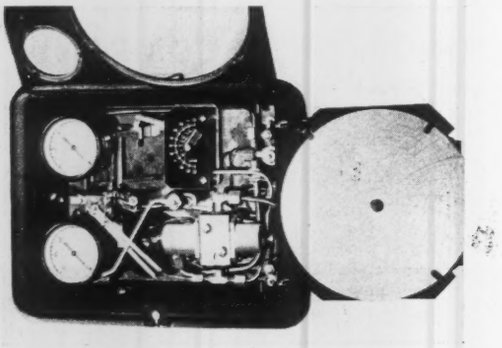
proof, splash-proof and fan-cooled construction. Its special features include: Frame rolled from steel plate, feet and end-brackets of heavy pressed steel, welded construction and prelubricated ball bearings. The motors are available in sizes from ½ to 20 hp, in voltages of 208, 220, 440 and 550 for two or three phases. They are available in speeds from 865 rpm to 3500 rpm in 60 cycles, with lower speeds available for lower frequencies. Frames are NEMA Standard 203 and 326. Manufacturer's address is 306 Fourth Ave., Pittsburgh 30.

Resin Adhesives

COLD-RUN, fast-setting resin wood glue known as Wood-Lok, announced by National Adhesives, 270 Madison Ave., New York 16, is said to be the only type of resin glue that completely hardens to a working condition after 20 to 30 minutes clamping time. The material is not weakened by constant heating, and is a liquid ready for instantaneous use. Color of the material ranges from uniformly pure white to darker shades for special uses.

Pressure Controller-Recorder

PROPORTIONING type recorder-controller has been announced by Gotham Instrument Co., Inc., 149 Wooster street, New York 12. The unit is based on a recording mechanism having a high-accuracy bourdon-type spring

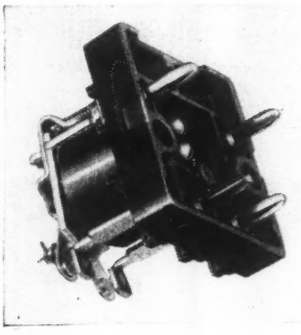


movement. It features automatic pen-arm lifter and V-notch, chart plate, an interlocking feature permitting one handed chart removal without the use of tools. The recorder is said to require only one-third the space of conventional units at no efficiency sacrifice.

Pressure Switches

THREE new eight-ounce pressure switches useful for either pressure or vacuum control up to 200 psi, have recently been announced. Useful for the control of fluids not corrosive to brass, the switches are said to be particularly applicable to the control of compressors, pumps, and carbonated-beverage equipment. Type M-500 has an externally adjustable range with fixed differential. Type M-600 can be reset manually from the outside. Type M-700 has an adjustable differential. Contact arrangement in the first two can be specified as normally-closed, normally-open, or doble-throw. The third design is available only with normally-open contacts. Rated at 10 amperes, 110 volts ac, the units have ⅛-inch pipe-nipple pressure connections. Manufacturer is the Aerotec Co., White Plains, N. Y.

Magnetic Relay

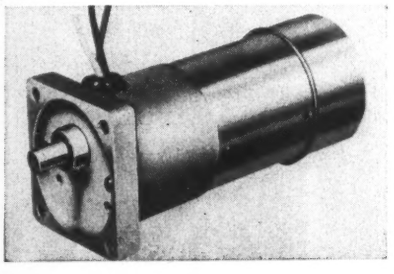


INTRODUCED by the Ward Leonard Electric Co., Mount Vernon, N. Y., new Bulletin 106 midget magnetic relays are designed for applications where remote or automatic operation is required. The relays, which are suitable for ac or dc operation on standard voltages and frequencies, are available single or double-pole and single or double-throw silver contacts. Single-break contact rating for standard relays is 4 amperes, 125 volts, ac noninductive. The devices are of the open type mounted on molded phenolic insulating base and, where enclosures are required, bakelite covers, steel covers, watertight boxes, etc., are available. The series includes the type provided with pin plug connectors, for mounting by plugging the relay in receptacles installed in the panel-board, thus permitting complete wiring of a circuit before relay is placed on the panel.

Welding Electrodes

AUTOMATIC arc-welding wires and tapes have been announced by the Air Reduction Sales Co., 60 East 42nd St., New York 17. The new line embraces five knurled type wires and five tapes for flat position operation, all highly recommended for low-cost automatic welding. The new material is manufactured in several diameters and designed to meet the general requirements of high-speed production welding. The automatic wires may be used separately or in conjunction with the tapes, depending upon the job to be performed.

Rotary Actuators



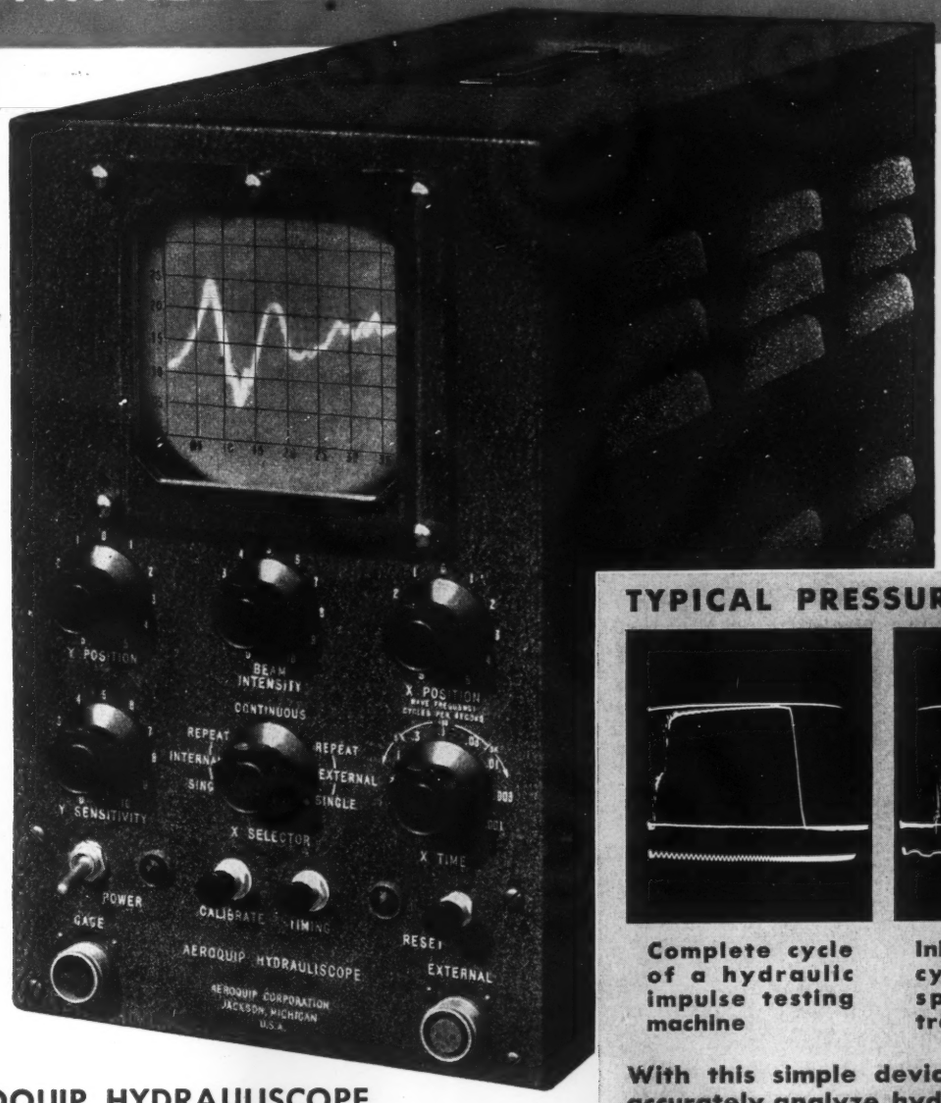
LIGHT-WEIGHT rotary actuator, developed by Lear, Inc., Grand Rapids, Mich. is now available. The actuator, Model 181, weighs 0.60-lb and has been designed for loads ranging from 0.1 to 15.0 lb-in., and for speeds from 2.5 to 375 rpm. With limit switches and connector it weighs 0.75-lb. The actuator incorporates the newest Lear motor and has output ratings from 0.4 to 15 watts at 24 volts dc. The motor is made in ac, dc and universal types for large range of voltages. Four standard gear reductions are

THE AEROQUIP HYDRAULISCOPE*

TO ANALYZE PRESSURE PHENOMENA

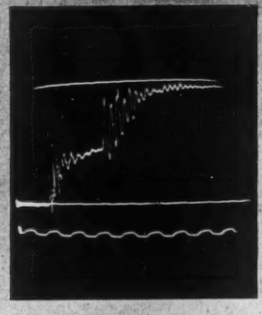
*Reg. Trade Mark

19472



TYPICAL PRESSURE GRAPHS

Complete cycle of a hydraulic impulse testing machine



Initial portion of cycle with the speed of time trace increased

With this simple device anyone can accurately analyze hydraulic pressure phenomena.

The AEROQUIP HYDRAULISCOPE is a high speed electronic analyzer, compact and portable, giving consistent results even when used by persons unfamiliar with electronic devices.

AEROQUIP CORPORATION

JACKSON, MICHIGAN

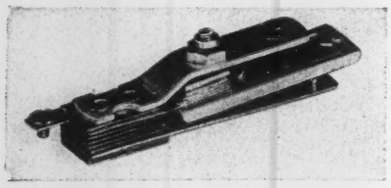
available giving 375, 70, 13, and 2.5 rpm with torque increasing with decreasing speed. The actuator was developed for such applications as remote valve operation, remote controls, etc.

Electronic Tachometer

TACHOMETER designed for measuring rotating speeds from 300 to 50,000 rpm has been announced by the Special Products Division of the General Electric Co., Schenectady. Weighing only 19 lb, the new instrument may be used to indicate speeds of motors, tools, engine, fans, blowers, etc. The electronic tachometer consists of a small pick-up head, six feet of flexible cable and a measuring unit with a panel-mounted indicating instrument reading directly in rpm. Either a high or low-speed head can be used with the instrument. Each pick-up head consists of a light-interrupting disk and a phototube. Light shining upon the phototube through the openings in the rotating disk produces input signals which are then transferred to the measuring unit which indicates the speed of the apparatus being tested.

Cut-out Switch

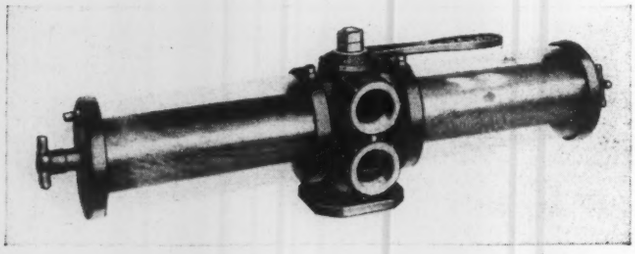
DESIGNED to cut off machines or appliances from power and remain inoperative until reset, a new Ulanet mica-insulted switch is now available. The unit is pile constructed and corrosion protected. Known as the Type RM Ula-Snap, it will cut out at any predetermined temperature and can be reset by pushing a fiber button. The



switch is rated at 1500 watts, 110-220 volts ac, and operates at temperature ranges of 0-150 F, 0-300 F, 0-700 F. Overall size of the switch including terminals is 1 inch by 1 inch by 3½ inches long. Manufacturer is the George Ulanet Co., 413-415 Market St., Newark 5, N. J.

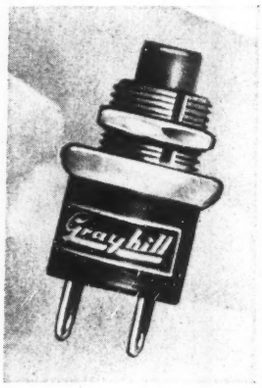
Pipe Strainer

NEW DUPLEX pipe line strainer made with a transparent Lucite casting permitting visual inspection is announced by the J. A. Zurn Mfg. Co., Erie, Pa. Large



open areas afford free movement of fluids throughout the unit. Area ratio is 16 to 1 when using 12-inch tubes and 8 to 1 when using 8-inch tubes. Flat horizontal design makes the strainer particularly adaptable to low, close-quarter installations. Strainers are made with bronze bodies and accessories, and baskets are available in brass, Monel, or other metal specified.

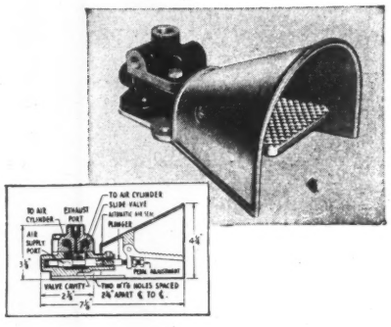
Push-Button Switch



MOMENTARY-CONTACT pushbutton switch known as Series 4000 is announced by Grayhill, 1 No. Pulaski Rd., Chicago 24. The unit features automatic return with momentary contact. As the button is depressed, a bridging contact at its base closes the gap between the two solder type terminals. Minimum number of moving parts greatly prolongs the life of the switch. The round phenolic base of the switch is 0.656-inches in diameter and 0.625-inch in depth. The plunger assembly protrudes 0.531-inch in front of the base and is enclosed in a bushing with hex nut. The unit is rated at approximately 1/2-ampere at 110 volts.

Foot-Operated Valve

PNEUMATIC VALVE, foot-operated and designed to meet the demand for highly adaptable industrial all-purpose valves has been announced by the National Pneumatic Co., Rahway, N. J. The valve is so designed that it can be arranged for opening on pedal-depressed or pedal-raised position. It measures 7 1/8 inches deep, 5 1/2 inches wide and 4 1/4 inches high. Every factor of safe trouble-proof operation is said to be considered. Operating pedal of valve is adequately shielded to pre-



vent accidental operation which might result in damage or injury. It is painted alert orange in conformity with modern color engineering and has short travel for fast operation. Air seal of the valve is automatically adjusted by the air pressure. Seal friction is always at a minimum

LEATHER

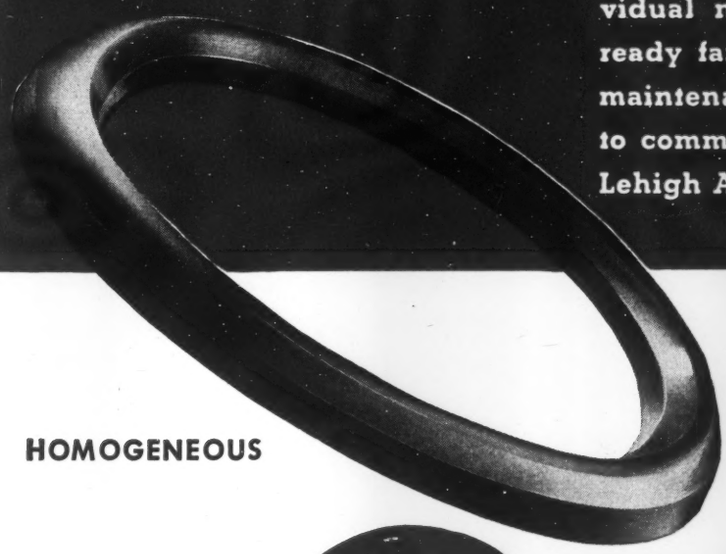
FABRICATED

NOT JUST ONE TYPE OF PACKING

-BUT 4

. . . PLUS A DESIGN SERVICE ONLY HOUGHTON CAN RENDER

Being "neutral," in that we supply both leather and synthetic rubber packings for all hydraulic and pneumatic applications, we can recommend the best type for each individual need. Our engineering service, already familiar and helpful to design and maintenance men the country over, is yours to command. E. F. Houghton & Co., 303 W. Lehigh Ave., Philadelphia 33, Pa.



HOMOGENEOUS

"O" RINGS

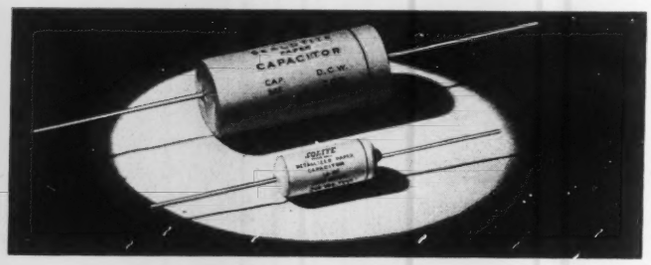
HOUGHTON'S

VIM LEATHER AND VIX-SYN PACKINGS

with air leaks eliminated for life of the valve. Every operation laps the manganese-bronze slide valve to its cast-iron seat, thus improving effective sealing against wasteful loss of air.

Capacitors

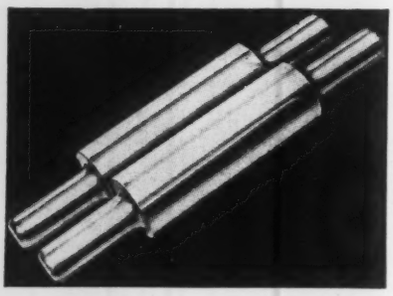
SELF-HEALING midget capacitors, approximately one-fourth the size of conventional designs have been developed by Solar Mfg. Corp., 285 Madison Ave., New York. The new condensers use a unique self-healing metallized



paper construction resulting in small size and sturdiness. The capacitors, known as Solite, utilize a metallic coating, approximately 25 millimicrons thick, deposited on paper. Thin film permits the use of a single-sheet dielectric and contributes to the self-healing properties of the unit.

Strip-Mill Rolls

KENNAMETAL ROLLS for cold-strip mills are now being marketed by Kennametal Inc., Latrobe, Pa. Studies are said to have demonstrated that more can be produced with these new rolls than with conventional types before regrinding is necessary. Thinner, harder materials



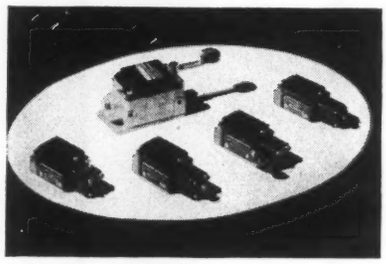
are said to be satisfactorily rolled, accurate gage maintained more consistently. The rolls, which are produced to customers specifications, are capable of giving a 1.5 microinch finish to a nickel strip, with equal results obtainable in rolling carbon and stainless steel. The material is said to have excellent torsional strength, nongalling properties, and high modulus of elasticity.

Low-Load Snap Switch

NEW ULTRA-PRECISE switch for the automatic sorting of small parts may now be obtained from the Micro Switch Division of the First Industrial Corp., Freeport, Ill. The new switch, interchangeable with other basic switches of the Micro Switch line, has a repeatable accuracy of 0.0001-inch. This high precision over hundreds of thousands of operations is said to be made possible by selection of carefully stabilized parts, use of an accurately-fitted bronze plunger guide, and special means to insure that operating force is always applied to the switch spring at exactly the same point.

Limit Switches

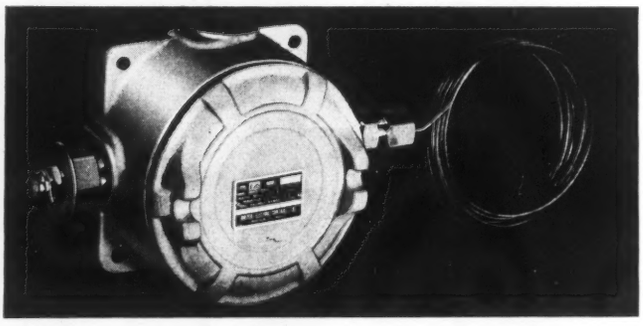
LINE OF limit switches manufactured by the General Electric Co., Schenectady, N. Y., has been expanded by the addition of a new small, oilproof, track-type switch designed for machine tool applications. The new switch contains a single-pole, double-throw, self-contained snap-action control Switchette. A sturdy, molded-phenolic enclosure of oilproof construction protects it from lubricating or cutting oils and compounds. It can be used in a wide

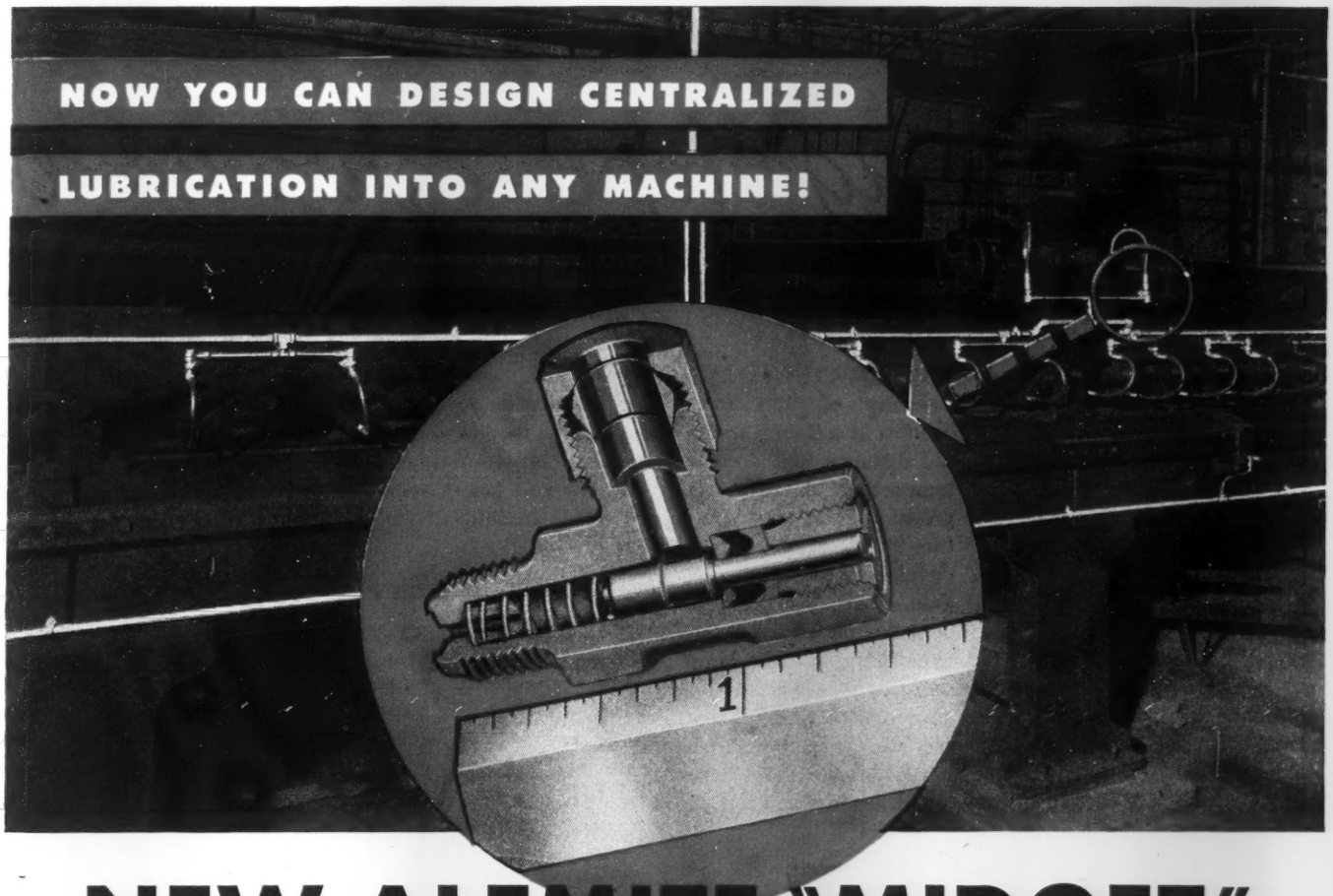


variety of operations through the use of interchangeable operating heads for roller-lever, roller-push-rod, push-rod or plunger operation.

Thermostat

EXPLOSION-PROOF thermostat having calibrated adjustment is now being marketed by United Electric Controls Co., 69-71 A St., Boston. The new thermostat, known as the Type EJO has an external calibrating adjustment for models with 120 F or 250 F range covering −120 F to 600 F. The new thermostat is a low-cost explosion-proof control especially designed for applications where dangerous dust and fumes are prevalent. Mechanism is located in an approved housing, the cover of which is threaded for easy removal. Electrical ratings are: 1200 watts, 115-230 volts noninductive and 300 watts, 115-230 volts inductive, both alternating current.



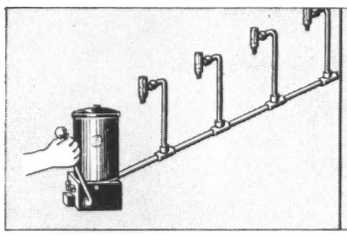


NEW ALEMITE "MIDGET"

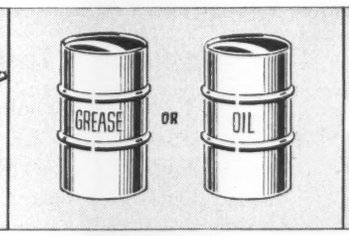
Centralized System — Smallest, Simplest Made

Here's a new lubricant measuring valve for a centralized system. It is only slightly larger than the average Alemite fitting and makes centralized lubrication exceptionally inexpensive. Its compactness makes it easy to apply to present designs, easier to incorporate into new ones.

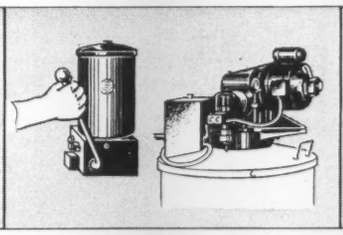
The Alemite Lubrication Specialist will be glad to consult with you on how the new Alemite "Midget" Lubrication System can be included in your designs. Call the nearest Alemite distributor, or write Alemite, 1804 Diversey Parkway, Chicago 14, Illinois.



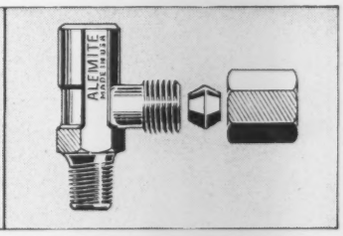
Low Cost, Single Line System. The valves can be mounted on or near bearings, to deliver a measured amount of lubricant from one central point while the machine is producing. No shutdowns, no bearing failures.



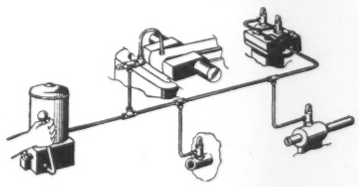
Handles Oil or Grease. There is no danger of over-lubrication or under-lubrication. An indicator signals when the lubrication is completed — eliminating human error. Production goes up . . . costs go down.



Manual or Automatic Operation. A hand pump may be installed in a safe, convenient place on the machine. Or, an Alemite air or electrically operated control will handle a group of machines automatically.



Built-In Compression Fitting is an integral part of the valve and included at no extra cost. No additional fitting is needed to connect tubing to the valve. This is an exclusive Alemite feature.



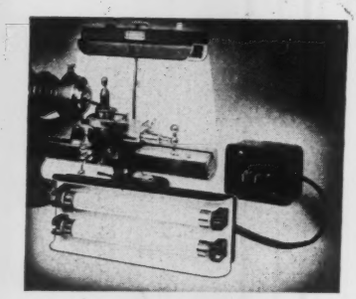
Serves Any Type of Bearing. Installation accessories are available so that the system can be adapted to rotary, oscillating, stationary—plain or anti-friction bearings.

ALEMITE
REG U S PAT. OFF
Centralized Lubrication Systems

Another Product of STEWART WARNER

engineering dept equipment

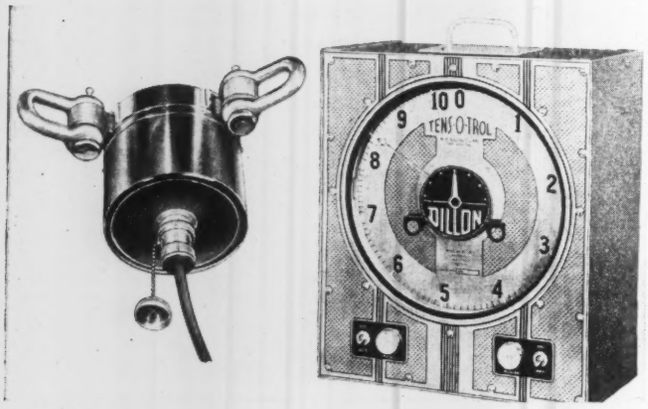
Miniature Fluorescent Lamp



PRODUCING a light intensity of 550 foot-candles at a 3-inch working distance and a color temperature of 3500 degrees Kelvin, a miniature fluorescent lamp, developed by Stocker & Yale, Marblehead, Mass., operates on 115-volt 60-cycle current. The lamp uses twin 4-watt bulbs of standard manufacture and is finished with baked black wrinkle exterior and baked white enamel reflector. Normally supplied with a nonadjustable bracket and harmonizing cast base it may be supplied less the support.

Tension and Weight Indicator

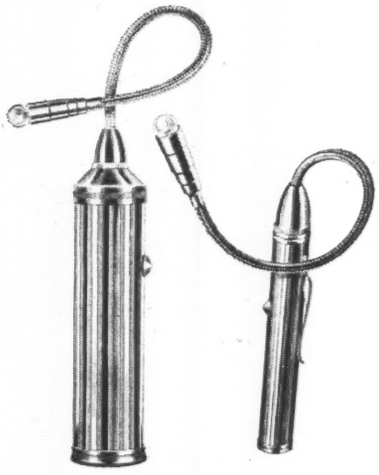
NEW-TYPE indicator operating by the use of precision dynamometer and self-synchronous motors has recently been announced by the W. C. Dillon Co. Inc., 5410 West Harrison St., Chicago 44. The unit utilizes a remote dynamometer that may be as far as 300 ft from the indicating station. Unit is sensitive requiring only 40 thousandths of an inch deflection to render full-scale reading. Indicator measures force pulling on dynamometer unit by unbalancing field of dynamometer.



Synchronous-Speed Tachometer

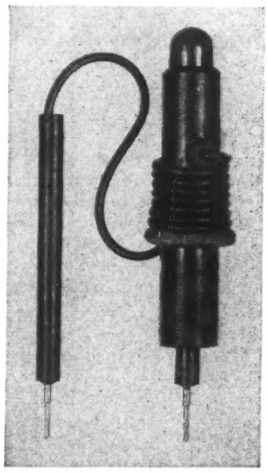
NOW AVAILABLE is a new synchronous-speed tachometer for measuring speeds in the synchronous speed range of 1800 to 3600 rpm. In operation, a mechanism periodically charges a condenser through a dc milliammeter, thus measuring average current. Scales are exactly linear and easy to read with an accuracy to ¼ of one per cent. The unit operates from 115-volt ac power line and uses no vacuum tubes. Three styles are available: Type 48A for speeds above synchronism, Type 48B for speeds below synchronism, and Type 48C gives equal spread above and below synchronism. Unit is manufactured by Metron Instrument Co., Denver, Colo.

Flashlight



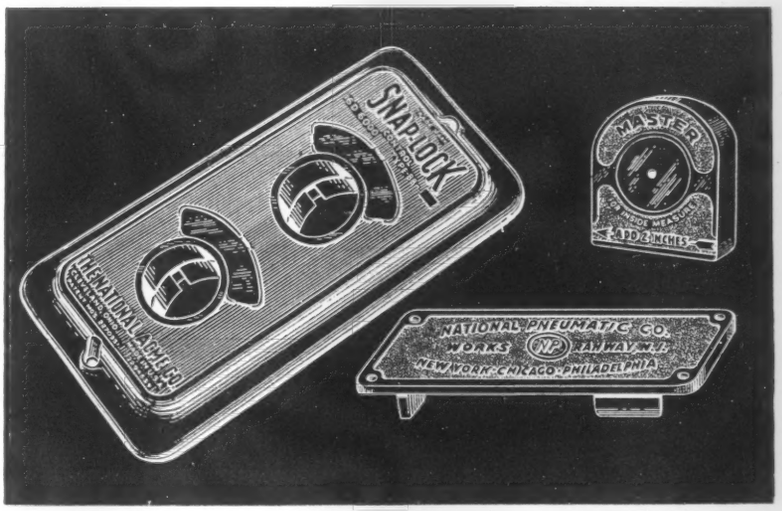
INTRODUCED by the Holub Industries, Inc., Sycamore, Ill., a line of flashlights has flexible tubing joining the light to the battery case. The tubing is of such a nature that it will retain its position when bent in any direction. The light is useful for reaching hard to get places such as inaccessible machinery and instruments. Catalog No. 132 uses two regular flashlight cells, Catalog No. 131, equipped with pocket clip, uses two AA penlite type batteries.

Test Lamp



TEST LAMP and voltage indicator for use on 100 or 60 volt circuits has been announced by Holub Industries, Inc., Sycamore, Ill. The unit known as HI Tester consists of a filament-type lamp, housing and contact leads. It may be used on ac or dc circuits to locate grounds, open circuits, blown fuses, etc. The unit gives definite signals in brightly lighted as well as dark places without confusion. No fuses are required for safety. The instrument is available in two types, catalog No. 61 for 110 to 600 volt range and catalog No. 62 for 110 to 440 volt range.

PRACTICAL CONSIDERATIONS IN DIE CASTING DESIGN

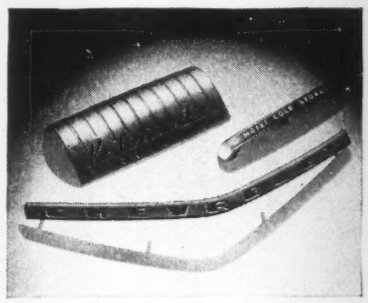


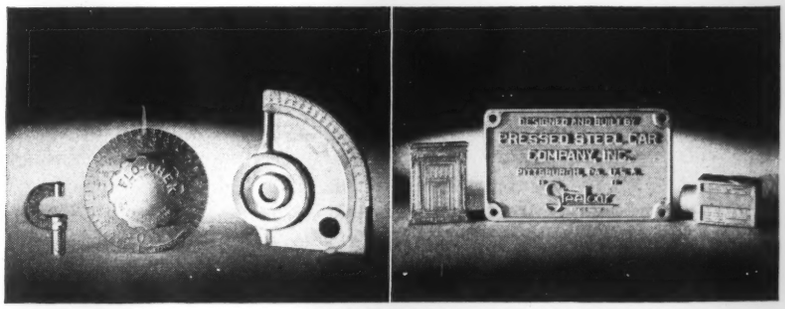
LETTERING IS EASILY OBTAINED IN DIE CASTING

In designing die castings, keep in mind that lettering, numerals, trade marks, diagrams or operating instructions can be cast on the surfaces. But lettering should be so designed and placed as to facilitate die construction and removal of the castings from the die.

Raised, rather than debossed, lettering should be specified, since it is less costly to cut a design *into* a die than to make a raised design *on* the die surface. If, however, the lettering on the casting cannot project above the surface, debossed lettering can usually be achieved by using raised lettering on a removable panel set into the die. In any event, lettering should be done on surfaces parallel—or nearly parallel—to the die parting and should never constitute an undercut which will interfere with removal of the casting from the die.

A variety of lettered zinc alloy die castings—some old, some new—are illustrated here. Those in the drawing above indicate the use of raised letters and numerals on contrasting stippled or corrugated backgrounds. The depressed lettering on the castings in the above photograph permits filling-in with paint to contrast with adjacent surfaces (see finished handle with lettering "MOIST COLD STORAGE"). The castings in the two photographs below illustrate a variety of raised lettering and numerals.





ALLOY SELECTION

Equally important to the design of a die casting is the selection of the proper alloy for its production. The zinc alloys used in the die casting industry conform to specifications of the American Society For Testing Materials and the Society of Automotive Engineers (see table below). When a casting is properly designed and the alloy composition is carefully controlled with respect to every element involved, outstanding mechanical properties and dimensional stability will be assured in zinc alloy die castings.

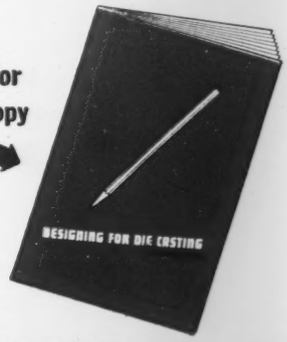
Zamak* and Corresponding A.S.T.M. and S.A.E. Alloys

	A.S.T.M.	S.A.E.
Zamak-3	XXIII	903
Zamak-5	XXV	925

*A trade mark (registered in the U. S. Patent Office) identifying the zinc alloys developed by The New Jersey Zinc Company and used in the die casting industry.

For additional data on die casting design ask us—or your die casting source—for a copy of the booklet "Designing For Die Casting."

Send for your copy



ZINC
FOR DIE CASTING ALLOYS

The New Jersey Zinc Company, 160 Front St., New York 7, N. Y.

The Research was done, the Alloys were developed, and most Die Castings are based on
HORSE HEAD SPECIAL (99.99 + % Uniform Quality) ZINC

Design Abstracts

Starting Aircraft Gas Turbines

AS THE size of turbojet engines and, particularly, gas turbine engines increases, the required starter power increases at a much greater rate than that for conventional reciprocating type aircraft engines. For example, a starter system for the General Electric type TG-100 gas turbine engines may be requried to deliver approximately 70 horsepower maximum in order to obtain a start in 60 seconds, whereas a starter for an engine rated at approximately twice the output may require a starter to deliver up to 250 horsepower. In comparison, increasing a reciprocating-type aircraft engine displacement by a factor of two increases the starting power required by a factor of approximately one and one-half. Conventional reciprocating engines generally employ the 28-volt d-c direct-cranking starters. The largest such starter now being used is rated at approximately five horsepower and weighs approximately 28 pounds.

To meet the requirement of larger starter systems, a small turbine starter mounted directly on the engine and powered by a solid propellant contained in a cartridge is being developed. It is anticipated that the unit will weigh approximately 115 pounds, including the propellant necessary to start a gas turbine engine in 30 seconds. Weight of the propellant is approximately 30 pounds which results in airborne weight approximately 85 pounds.

There is under development at the present time a starter system which will employ the power available from an airborne auxiliary power plant for the supply of electrical power necessary during operation of the aircraft. During the starting period the entire capacity of the auxiliary power plant is available. At the present time a hydraulic system being developed for use with this drive appears to yield an economical result. It is anticipated that such a system may be installed at a weight cost of less than 50 pounds per aircraft engine based on a 25 to 30-horsepower starting demand.

Considerable thought has been given to the possibility of using the excess power available at sea level from turbo-alternator units currently under development. Such a unit, which is designed to be capable of delivering approximately 100 horsepower at 40,000-feet altitude, potentially will be capable of delivering in excess of 400 horsepower at sea level, all of which may be considered to be available for starting. At the present time it appears that a small gas starter turbine mounted on the aircraft engine will provide the most satisfactory system. The power available from the turbo-alternator unit may be transmitted to the starter turbine by (1) the further expansion of the exhaust gases through the starter turbine, or (2) bleeding the excess air available from the compressor and utilizing the exhaust from the turbo-alternator unit regeneratively. It is anticipated that such a system rated at 400 to 500 horsepower will impose a starter system weight of less than 50 pounds per engine.

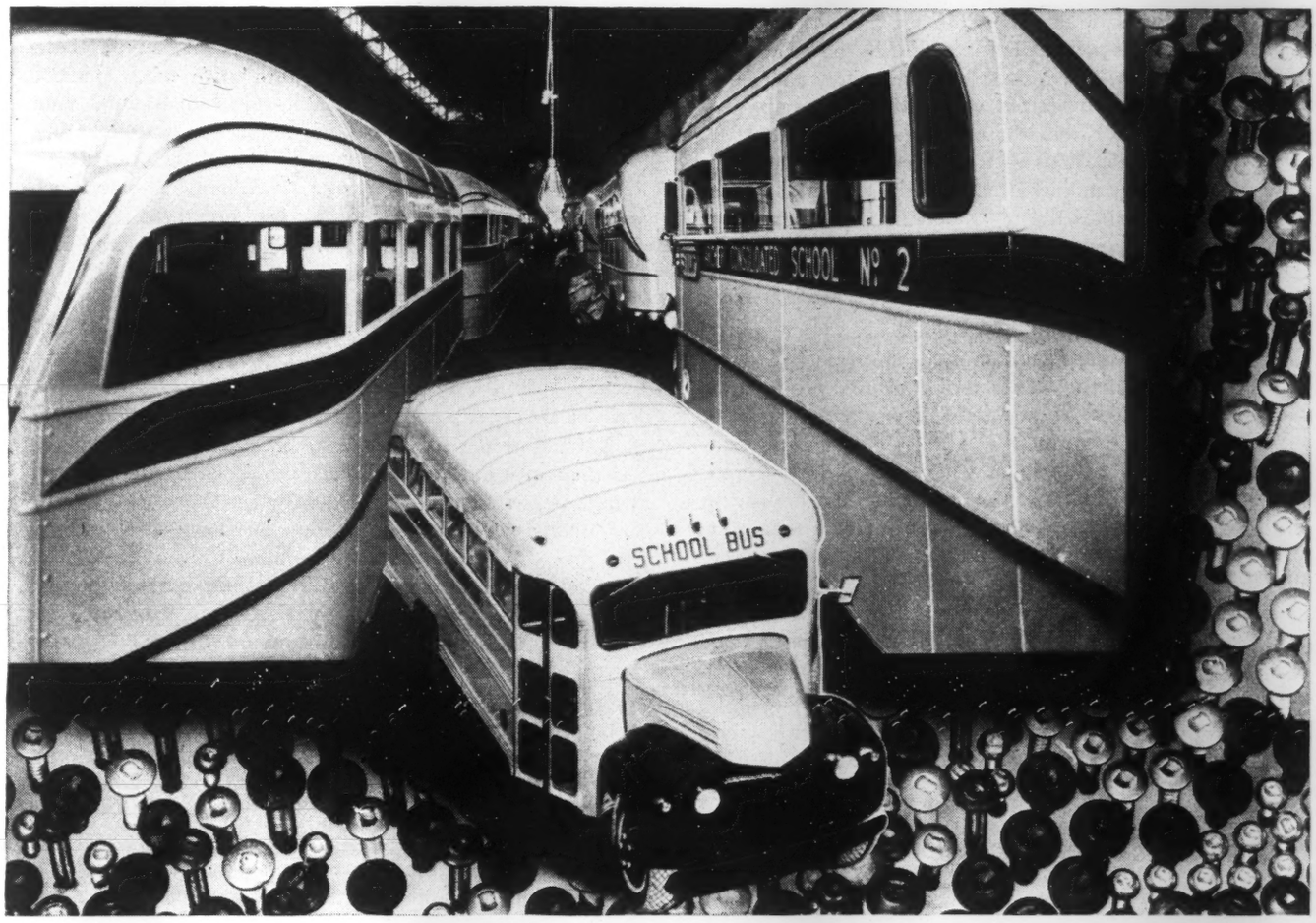
As the size of the gas turbine engines increases and as the starter power requirements correspondingly increase, it may not be practical to provide aircraft with self-contained starter systems. The requirement of self-contained starter systems appears to be motivated by the memory of forced landings in pastures, highways, and emergency landing strips. It should be realized, however, that future aircraft which will be powered by large gas turbine engines having high starting requirements will not be capable of successfully landing or taking off under the aforementioned conditions. For this reason, external or ground-powered starter systems are also being investigated. It is anticipated that mechanical, hydraulic or compresser-air transmission types of ground-powered starter systems will each result in approximately the same airborne starter weight per aircraft engine, i.e., less than 50 pounds for a starter system rated at from 400 to 1000 horsepower.—*From a paper by A. G. Bardwell Jr., Captain, Air Materiel Command, presented at a recent joint meeting of the American Rocket Society and the ASME.*

Naval Machinery Standardization

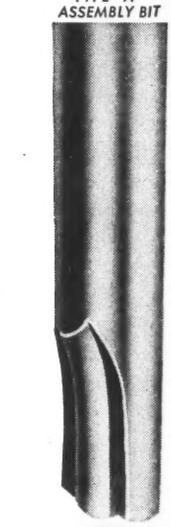
WHEN this country undertook naval shipbuilding on a modest scale in 1933, a group in the Bureau of Engineering of the United States Navy and in the shipbuilding industry decided to ask the builders of central station machinery to participate in the design and construction of the boilers, turbines, auxiliaries, condensers and gears of some of these vessels. The result of this collaboration was the development of a new type of high-speed, lightweight and sturdy propulsion machinery for a group of high-powered destroyers that set new records for both reliability and efficiency.

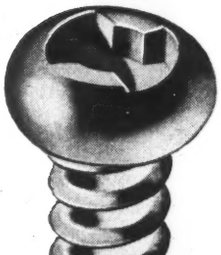
The designs were first undertaken in 1933, and the first trials were made in 1936. By 1938 the initial difficulties had all been ironed out to such an extent that this type of machinery was virtually standardized for the expanding naval building program that was being undertaken about the time of Munich. Then, when the vastly expanded two-ocean navy was undertaken, it was possible for the machinery which had been so developed to be built in many scattered factories by several different companies and in quantities never previously dreamed of, with complete confidence that the performance would be satisfactory. More steam turbine horsepower was produced for these ships in four years than had been produced for central station use in the preceding 35 years. As a result, despite the unprecedented speed of shipbuilding, power plants were never limiting factors on production. Further, the Navy had machinery of a reliability and cruising radius which probably played a major role in the highly successful naval operations which were carried out on both sides of the world.

Following several conferences with the shipbuilders and



TYPE "A" ASSEMBLY BIT





COMMON SCREWDRIVER

THE HICKS BODY COMPANY

FINDS 7 MAJOR CLUTCH HEAD ADVANTAGES

At the Hicks Lebanon, Indiana, Plant, they produce School Buses which have to meet exacting strength standards for safety and security under operation in all types of climates from Maine to Florida. These bus bodies are all-steel sectional construction. As a result of change-over to CLUTCH HEAD Screws, the Hicks Body Company report:—

1. A 15% step-up in assembly driving operation.
2. Skid hazard materially reduced by dead-center entry for automatic straight driving.
3. Non-tapered driving faster, easier, and less fatiguing.
4. Operators find absence of ride-out with CLUTCH HEADS an important safety factor.
5. The Lock-On, uniting screw and bit as a unit, a decided advantage for one-handed driving.
6. 50% more screws driven by the Type "A" Bit before need for reconditioning.
7. Over 50% reduction in tool maintenance cost because of simplified 60-second reconditioning.

Investigate what these and the several other exclusive CLUTCH HEAD advantages mean in savings to your assembly line. We invite you to send for

CLUTCH HEAD · SCREWS ·

package assortment of CLUTCH HEAD Screws, sample Type "A" Bit, and illustrated Brochure... by mail, and without obligation.

UNITED SCREW AND BOLT CORPORATION

CLEVELAND 2 CHICAGO 8 NEW YORK 7

the naval architects, it developed that what was wanted was a steam turbine power plant of radically new and forward-looking design, which must meet the Navy specification of 42,000 horsepower per vessel at 385 pounds per square inch and 620 F temperature at the turbine throttle, the prevailing specifications of the Bureau of Engineering of the Navy. With modifications in superheaters and no changes in the turbines the machinery was to be able to produce 52,000 horsepower per vessel at 400 revolutions per minute when operating at 375 pounds per square inch and 825 F at the throttle. Further, it was desired that the basic design be capable of modification to somewhat higher pressure for subsequent ships.

Mr. A. A. Ross of the General Electric Co. proposed a radically new type of "locked-train" main propulsion reduction gear which permitted building a double-reduction gear of great rigidity and light weight, and which would permit use of much higher speed turbines than had been used before. This new gear would permit turbine speeds of just under 6000 and 5000 revolutions per minute for the high-pressure and double-flow, low-presure turbines, respectively, with a normal full-power propeller speed of about 400 revolutions per minute. This high speed permitted reducing the diameter and the between-bearing spans of the turbines appreciably, compared to the slower-speed turbines required by single-reduction gears. For example, the between-bearing span of the high-pressure turbine was reduced from more than 9 feet to 6 feet.

Four Turbine Sizes Covered Wide Range

Although it cannot be said that complete standardization was obtained, in the final analysis only four sizes of turbines were involved in powering approximately 95 per cent of the main combat ships, including battleships, aircraft carriers and cruisers as well as destroyers. These turbines had a normal maximum rating of 25,000, 30,000, 37,500, and 53,000 horsepower, respectively, per propeller shaft. Except for size, cross-sections of these various turbines can scarcely be distinguished one from the other. A high degree of standardization and interchangeability was effected between the parts of the several 25,000 and 30,000 horsepower designs. Lists of interchangeable parts such as turbine buckets, diaphragms, packings, bearings, oil deflectors, nozzles, etc., were compiled by the design group and the Navy which greatly facilitated servicing.

Comparatively few difficulties were encountered on these turbines. This has been most gratifying in view of the fact that they involved so many radical innovations and particularly since we in this country had had so little experience in building machinery to withstand the conditions of modern naval warfare. The reliability of the lightweight, high-speed turbines installed originally on the destroyers proved greater than that of any of the former heavier propulsion machinery used in capital ships, and these newer turbines were much higher in efficiency.

Turbines used on the battleships had no greater specific weight than those used on the destroyers, and the performance under the greater duty imposed by the heavier ships was equally satisfactory. This may indicate, as is being thought by many today, that the factors of safety used for destroyers are unduly high, and that further advantages in reduced weight might be obtained in new ships by designing for somewhat higher stresses and reduced life. As a matter of fact, the factors of safety and design limitations on parts subject to vibration on these light turbines were made more conservative, on account of the hazards involved in variable-speed operation, than those which previously had been put into public utility turbines intended for continuous-duty performance.—*From a paper by G. B. Warren, Turbine-Generator Engineering Division, General Electric Co., presented at the annual meeting of The Society of Naval Architects and Marine Engineers, in New York.*

Future of Magnesium Applications

A GRADUAL reduction in manufacturing costs of magnesium products may be expected even though the general trend of materials prices is on the upward swing. Costs should come down when a reasonably large and steady volume of production has been attained and new processing developments are more fully utilized. The enclosed and automatic handling of molten magnesium will be of major importance in the casting field, comparable with the importance of continuous strip rolling in the sheet field. Large closed furnaces, pumps, pipes, and valves will provide more uniformity of metal and higher efficiencies and will result in lower metal and flux losses. This development has been talked about for some time, and progress is being made. It will be valuable for both the magnesium foundry and the magnesium die-casting plant. In Germany the Mahle Co., with twenty years experience in magnesium die casting, have made use of some of these principles in their hot chamber die-casting machine and have claimed advantages of efficiency and economy for it over cold chamber die-casting machines.

Recent developments in electroplating magnesium give promise of providing an economical and decorative surface for applications where exposure is not too severe. This could be an important factor for magnesium in cameras, compacts, household equipment, and fittings of all kinds. Cladding of sheet with a more anodic magnesium alloy can be made available to remove any chance of stress corrosion of structural sheet where there are services with sufficient stress and exposure to demand it.

The importance of the surface condition of a metal for its fatigue strength is well recognized. Techniques for shotblasting or otherwise working the surface of magnesium parts give promise of extending the serviceability of magnesium for applications which are highly stressed dynamically. Such techniques were being put into practical use in Germany.

In the alloy composition field, which is always the most intriguing, there is a great deal of activity. There are more people working on metallurgical research in magnesium than ever before, so that developments should come faster in the future than in the past. However, as important as these discoveries will be and as vital to the foundations of the magnesium industry, it is unlikely that they will increase the volume of magnesium business any quicker than good, industrious and ingenious use of the properties and characteristics of magnesium which are already lying at our door step, waiting to be recognized by engineers and businessmen.—*From a paper by Dr. J. D. Hanawalt, Magnesium division, The Dow Chemical Co., presented at a recent meeting of the Magnesium Assoc.*

For

Better, Faster Service

On Your

FRACTIONAL H.P. MOTOR PROBLEMS

. . . Use Our Direct Factory Representation by Trained Fractional H.P. Engineers

Through our engineers, we make available to you an accumulated wealth of F.H.P. motor engineering and production know-how. Consult with us NOW if your plans call for production-run quantities of small motors (1/500 to 1/15 H.P.) or blowers. A skilled, experienced factory engineer will help you solve your engineering and production problems right in your own plant . . . may help you lower product costs, improve product performance. Write today, outlining your problem.

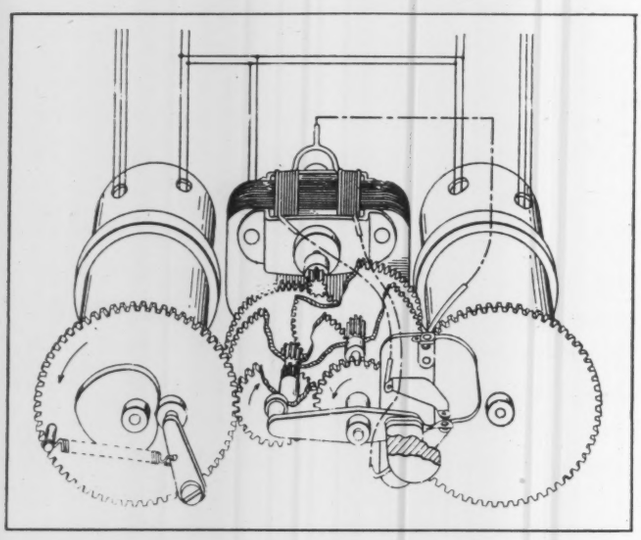
F. A. SMITH MANUFACTURING CO., INC.
550 DAVIS STREET ROCHESTER 2, N. Y.

FASCO

Pilot Fractional H.P. MOTORS & BLOWERS

Noteworthy Patents

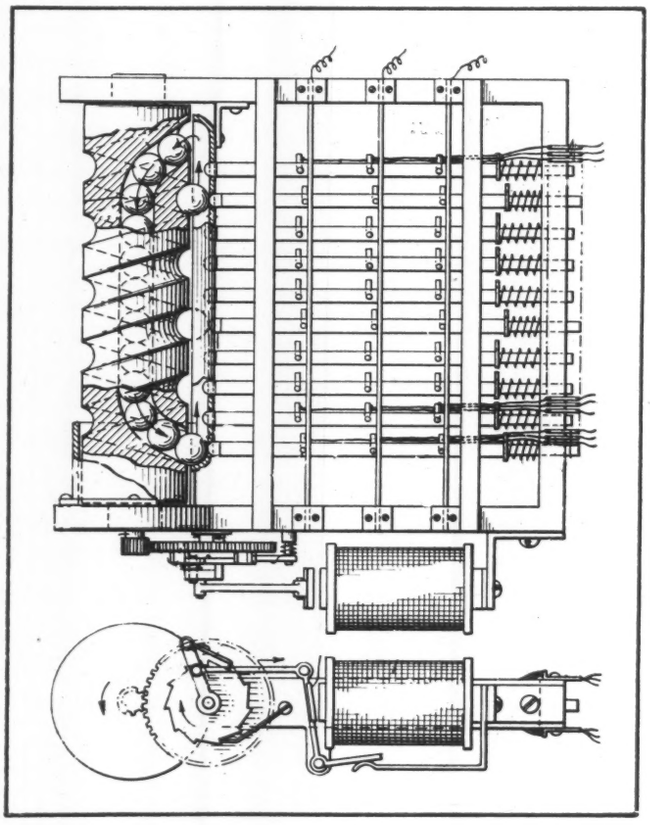
SELF-SYNCHRONOUS receiving and transmitting system, requiring no slip rings to conduct electricity between moving and stationary parts, is covered in patent 2,407,-200. Assigned to Bendix Aviation Corp. by Louvan E.



Wood, the follow-up mechanism of the system embodies a speed reduction of such a degree as to effectively prevent the response sensitivity of the driven member from producing oscillation or overshooting when the transmitter actuator oscillates. Embodying a flexible coupling and a torque responsive switch, the follow-up mechanism permits deviations of as much as 360 degrees between the driving and driven units and yet operates to bring the parts into synchronism.

TENSION VARIATIONS in aircraft control cables caused by drastic temperature changes are compensated for with a constant-tension device assigned to General Motors Corp. by Stuart Rockafellow under patent 2,409,-800. Applicable to any control cable system where movements do not exceed 3 feet, the compensator mechanism employs two grooved drums around which, in the case of an airplane, several turns of aluminum wire cable are wound. One end of the aluminum cable is anchored and the other attached to the arm of a lever system which operates to effect shortening or lengthening the steel control cable and maintain substantially constant tension.

MULTIPLE CONTACTS, using only one stepping magnet, are obtained with a unique selector switch design in patent 2,406,028. Assigned to Bell Telephone Laboratories, Inc., by Oscar Myers, the switch utilizes balls to act as contactors. Carried in a straight line by a vertical guide piece, the balls are moved to actuate the various contacts by means of an appropriate spiral thread on a



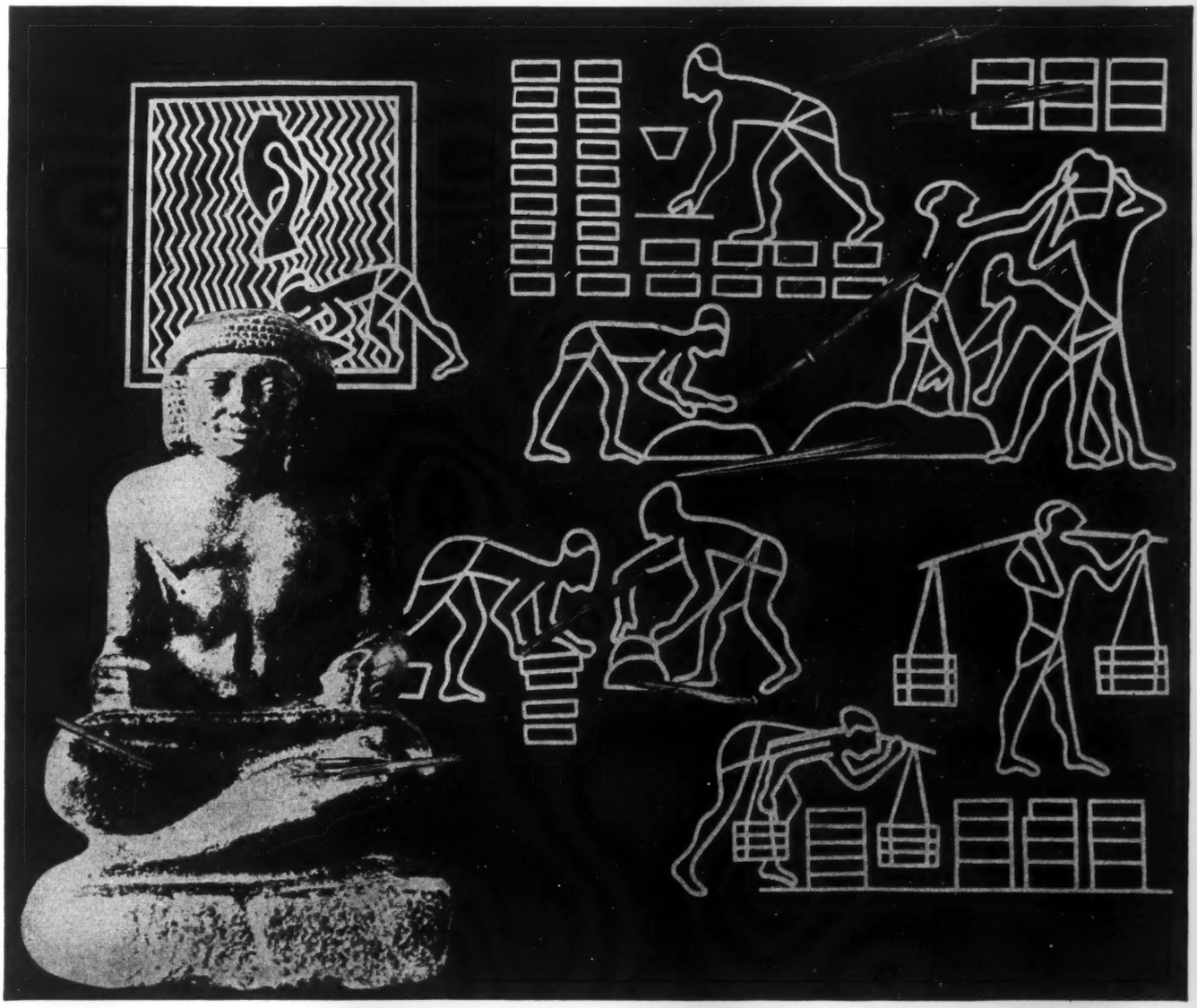
revolving drum which is in turn actuated by the stepping electromagnet with a ratchet arrangement. Any number of balls can be carried in the guide to establish succeeding connections in the relationship desired.

BRICKS WITHOUT STRAW

Long, long ago a penny-conscious Pharaoh tried to cut his cost corners by decreeing that bricks would be made without straw. He found out—the hard way—that scrimping on materials throws product performance and customer good will into full reverse.

Hardenability in steel is analogous to straw in bricks. Leave it out and you invite trouble in. Molybdenum steels combine good hardenability with economy, thus insuring good performance on a practical cost basis.

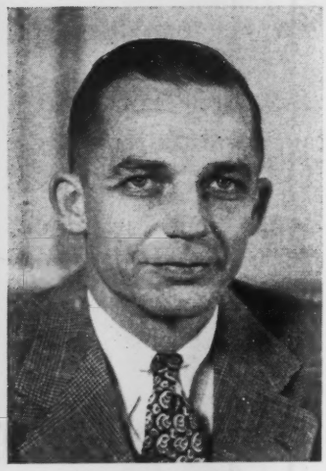
The Pharaoh may possibly have lacked data on the importance of straw in bricks—but there is readily available to all steel users a wealth of practical facts on the advantage of molybdenum-containing steels. Investigate *now!*



MOLYBDIC OXIDE—BRIQUETTED OR CANNED • FERROMOLYBDENUM • "CALCIUM MOLYBDATE"
CLIMAX FURNISHES AUTHORITATIVE ENGINEERING DATA ON MOLYBDENUM APPLICATIONS.

Climax Molybdenum Company
500 Fifth Avenue · New York City

MOLY



Henry C. Hill

H. V. Williamson

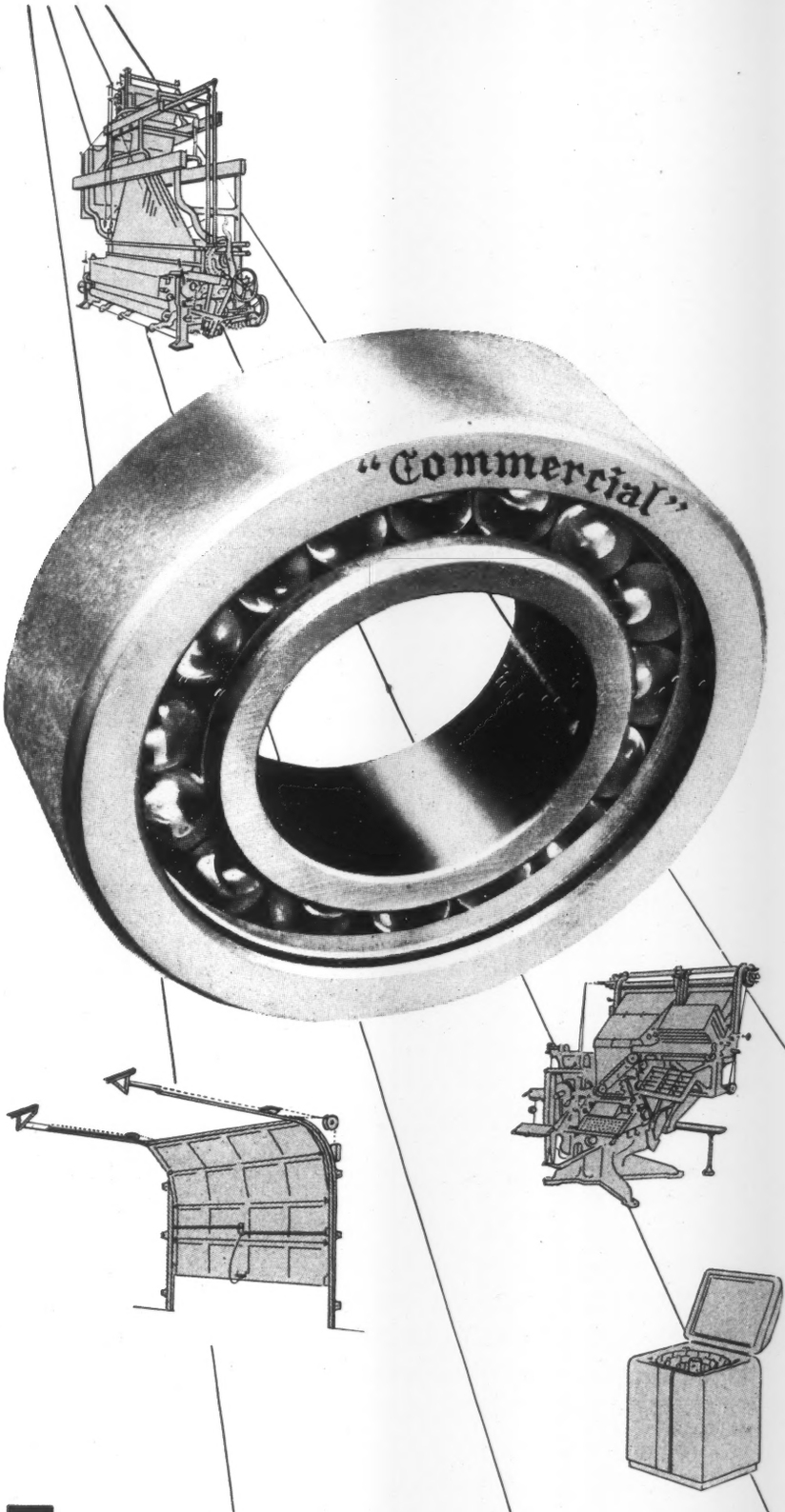
Victor S. Voigt

MEN...of...machines

HENRY C. HILL, in his new capacity as assistant director of engineering with Menasco Mfg. Co., will assist in the supervision of developing jet propulsion and gas turbine units which the company plans to introduce. Since 1928, and prior to becoming connected with Menasco, Mr. Hill had been associated with Wright Aeronautical Corp. as project engineer, first on the Whirlwind engine and then on the Cyclone. He was in charge of the design and development of the cyclone G-200 series 1200 horsepower models. Later as staff engineer he was responsible for the original design and development of the Cyclone 7-cylinder series, and handled the development of the R-3350 engine for the B-29 from 1941 to 1945. He also served as manager of the experimental division and manager of the special propulsion division, organized to handle newer types of jet propulsion engines.

H. V. WILLIAMSON, connected with Cardox Corp. since 1940 in various capacities, recently has been appointed director of research. He joined the Cardox organization as a research engineer and a year later was promoted to chief engineer of the research division. During this period his primary concern was with the development of methods and equipment for utilizing low-pressure liquid carbon dioxide for a variety of purposes. One of his early contributions was a snow separating nozzle for efficently projecting carbon dioxide on large outdoor fires, such as airplane crash fires. The range of the nozzle is such that the operator does not need protection against radiant heat, and normal wind conditions will not interefere with extinguishment. Prior to his connection with Cardox, Mr. Williamson had been associated with C. A. Dunham Co., developing a gas-fired home heating system. This was his first position after receiving his engineering degree.

VICTOR S. VOIGT, recently named chief engineer at The Bunnell Machine & Tool Co., Cleveland, is well equipped for his new position. His extensive engineering background and experience includes designing and building tools and machines for highly competitive projects as well as for those requiring extreme accuracy for such units as refrigerators, ranges, washing machines, binoculars, telescopes, radios, automobiles, aircraft, etc. Prior to his present as-



SCHATZ "COMMERCIAL" BALL BEARINGS have a knack for calling the turn wherever anti-friction performance is the need and low initial cost the problem.

Unlike other moderate-priced ball bearings, "Commercials" combine *through-hardened* chrome alloy precision balls and high-grade, carburized, hardened and tempered cold-rolled steel rings. What a difference this makes in added load capacity, resistance to fatigue and maintenance-free bearing life! That's why "Commercials" are equally at home in linotype machines and dishwashers, garage doors and jacquard looms, or in any bearing application which calls for day in and day out operating efficiency and economy.

Schatz "Commercials" cover the complete range of standard types and sizes ...are all alike in their low-cost, multi-purpose advantages. Fifty years of ball bearing specialization have seen to that.

Write "Schatz—Commercials" into *your* specs...then compare their on-the-job performance.

THE SCHATZ MANUFACTURING COMPANY
POUGHKEEPSIE, NEW YORK
REPRESENTATIVES LOCATED AT

Detroit	2640 Book Tower–26
Chicago	8 S. Michigan Avenue–3
Cleveland	402 Swetland Building–15
Los Angeles	5410 Wilshire Boulevard–36

SCHATZ "Commercial" BALL BEARINGS

The low-cost, multi-purpose ball bearing

sociation with the Bunnell company, he had been employed by The Westinghouse Electric Corp. at Mansfield, O., for many years.

♦

JOHN C. THOMPSON is now assistant chief engineer of McCulloch Motors Corp., Los Angeles. He has been discharged recently from the U. S. Army.

♦

PAUL R. GUERIN has resigned as assistant chief engineer of Towmotor Corp., Cleveland, to become assistant chief engineer of Johnston & Jennings Co., of that city.

♦

W. S. DUNCAN has joined V. & E. Mfg. Co., Pasadena, Calif., in an engineering capacity. Formerly Mr. Duncan had been chief engineer of the W. M. Welch Mfg. Co., and for many years was connected with Bell & Howell Co.

♦

JOHN C. MCPHERSON, previously director of engineering for International Business Machines Corp., New York, has been appointed manager of patent research and development for the company.

♦

ROBERT O. BENECKE, formerly an instructor in the mechanical and general engineering departments of Iowa State College, has recently been appointed assistant professor and head of the engineering department, University of Omaha.

♦

CLIFFORD P. GRAHAM, new chief engineer of C. L. Tanner Co., Los Angeles, has in the past six years developed a line of hydraulic valves used in the oil well industry and for hydraulic press operation, on which he has patents pending. Mr. Graham had formerly been chief engineer of Pacific Hard Rubber Co. & Western Molded Products Inc.

♦

JAY M. ROTH, previously project engineer with Thompson Products Inc., Cleveland, is now serving as chief engineer of Mechanisms Co., Uhrichsville, O.

♦

J. M. GWINN JR., who had been chief engineer of personal aircraft for Consolidated Vultee Aircraft Corp., has resigned to study the private-owner airplane field and particularly the possibilities of the flying automobile. Mr. Gwinn, whose headquarters are in San Diego, Calif., designed the two-control Gwinn car which received an approved type certificate in 1938, and has complete control of certain patent claims on two-control aircraft without rudders.

♦

ALBERT H. DEIMEL, formerly chief engineer of Spicer Mfg. Division of Dana Corp., is now chief engineer of the hydraulic transmission division of the Spicer organization.

♦

GORDON M. BUEHRIG, who had been connected with Raymond Loewy Associates, has become vice president in charge of designing for American Sports-Car Inc.

♦

EDWARD H. ALLEN has resigned as experimental engineer with Treen Engineering Co. to become chief engineer of the Servicycle Western Corp., San Francisco.

♦

JERRY GLASER has joined Northrop-Hendy Co., Hawthorne, Calif. as design and test engineer. Previously he had been mechanical engineer, National Advisory Committee for Aeronautics, Cleveland.

♦

CLOYD DICKERSON, formerly experimental engineer with Packard Motor Car Co., has become associated with the engineering staff of the Lincoln Division, Ford Motor Co., on developing engines.

♦

R. K. JACK, previously chief engineer, Reo Motors Inc., has been named chief engineer of the Divco Corp., Detroit.

♦

SEBASTIAN FLORES has resigned from the Brooklyn Navy Yard to accept a position as mechanical engineer with Babcock & Wilcox Co., New York.

♦

RAYMOND H. STOCKHARD has been appointed instructor of mechanical engineering, Rhode Island State College, Kingston. He resigned as assistant to the manufacturing manager, American Bosch Corp., Springfield, Mass.

♦

JAMES I. CLOWER, formerly at University of West Virginia, has been appointed professor and head of the department of mechanical engineering, University of Delaware.

What's New in Plastics

(*Continued from Page* 105)

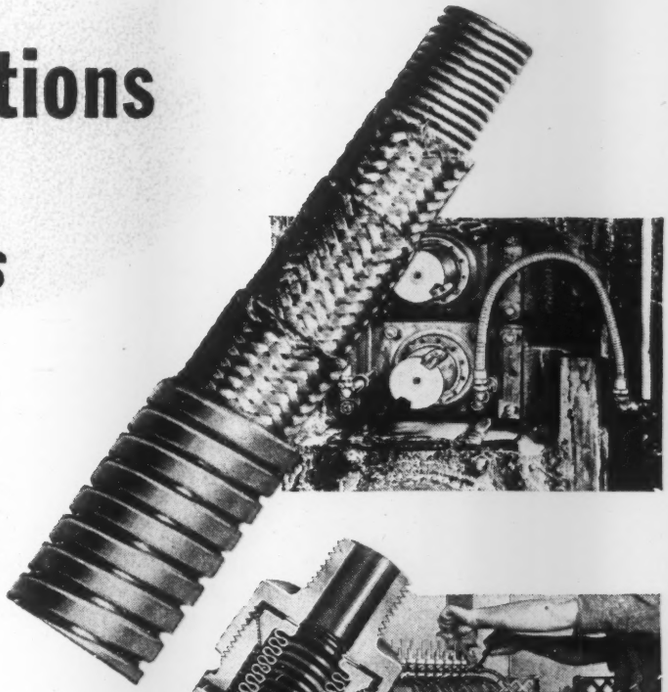
phenolic and furane resins have been employed for impregnation, though more attention has been given to polyester resins.

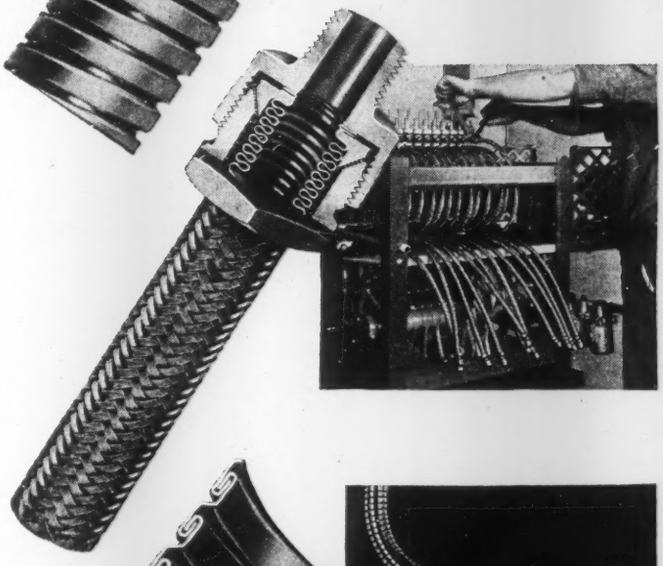
Polyester resins are relative newcomers to the plastics picture, though they offer unique characteristics in the fact that during curing or hardening, there are no by-products given off, holding shrinkage to a minimum. Catalysts are generally non-acidic in origin, various peroxides being employed. Some of the materials will harden slowly when exposed to the atmospheric origin, though others are not as sensitive to these conditions. Another interesting machine use made of these liquid resins is the impregnation of motor coils or windings. A more durable and more satisfactory assembly is obtained with liquid plastics which do not contain a high percentage of volatiles to leave voids upon their evaporation.

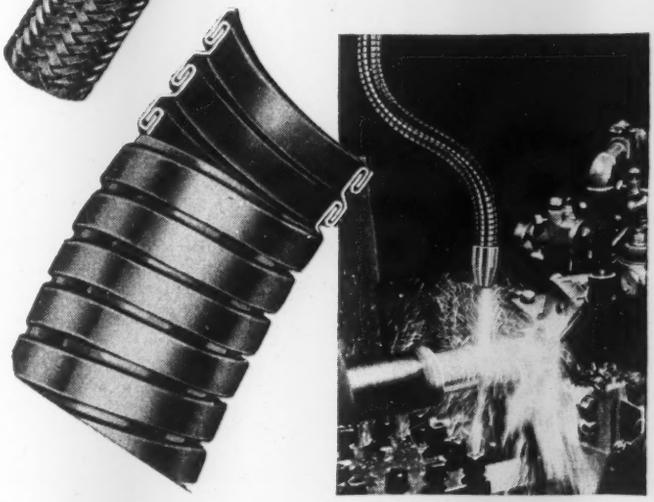
NEW USES OF PHENOLICS: Designs embodying thick wall sections undoubtedly will be employed more widely inasmuch as high-frequency preheating has made it possible to conduct economical molding cycles upon thick sections and to achieve uniform physical and electrical properties throughout the mass. Formerly, thin, uniform wall sections were imperative for stable designs. Phenol, urea, and melamine-formaldehyde will be prominently featured as in prewar years.

The possibility of reproducing complicated permanent magnets for special machines and instruments was enhanced by developments in casting mixtures comprising phenolic resin binders and finely divided permanent magnet materials. This activity was conducted by one of the group of investigators who studied German production methods and reported upon them during 1946. Pre-

3 TYPES OF *Flexible* Connections ...each offers distinct advantages







1

Withstands Frequent Flexing

"American" *Helical* Seamless Flexible Tubing. Particularly well adapted to services involving frequent or constant flexing. Available unbraided or with single, double or triple "basket weave" wire braid, with or without reinforcing armor, and with or without fittings attached.

2

Aids Maintenance Men

"American" *Annular* Seamless Flexible Tubing. Each convolution is a complete and separate circle or ring in itself. Heat proof Reattachable Couplings (illustrated) can be readily attached and detached with standard shop tools. Ideal where assemblies must be made up "on the job."

3

For Moderate Pressures

"American" Strip-Wound Metal Hose is available in four popular types, some without packing, others packed with asbestos, cord, rubber or wire. Made in brass, bronze, galvanized or stainless steel and other workable metals. Used for carrying steam, water, oil, hot air, grinder dust, chips or light, dry material.

ANACONDA
from mine to consumer

American
METAL HOSE

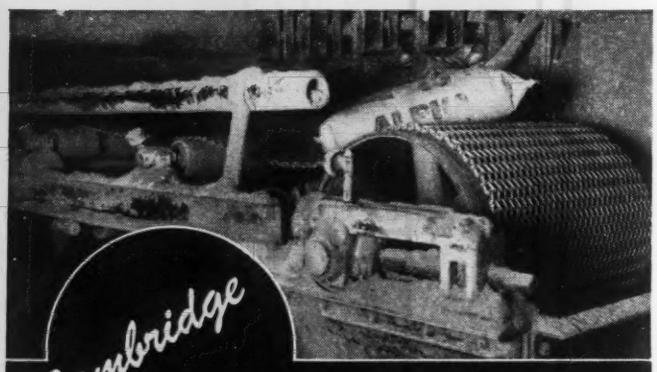
THE AMERICAN BRASS COMPANY

American Metal Hose Branch

General Offices: Waterbury 88, Connecticut
Subsidiary of Anaconda Copper Mining Company
In Canada: ANACONDA AMERICAN BRASS LTD.,
New Toronto, Ont.

IN THOUSANDS of plants throughout the country, flexible connections of the types shown are safely and economically conveying oil, water, steam, gases and semi-solids. Engineered to absorb vibration, compensate for misalignment, or allow for movement of parts, such connections withstand heat, pressure, abrasion and corrosion. Detailed information? Write for Bulletin SS-50.

40350



Cambridge

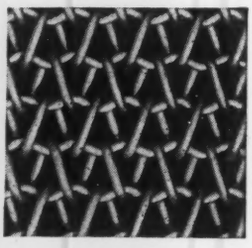
BALANCED BELTING

Guards product cleanliness in processing and handling

Typical of the efficiency of Cambridge Balanced Belting is this use in conveying packaged cement. The sturdy open mesh permits loose cement to sift through the belt, keeping the bag clean during handling. For efficient, dependable service in handling or processing your products—at reduced costs—it pays you to use Cambridge Balanced Belts.

For the practical, economical solution to your conveying problems—write Cambridge today, Dept. 20.

Close-up showing alternate spiral construction and crimped wire connection of Cambridge Balanced Mesh Belt.



FREE....

Valuable, illustrated catalog. Complete, practical reference for all belt users. Write Dept. 20 for your copy.

CAMBRIDGE WIRE CLOTH CO.
CAMBRIDGE, MARYLAND

Boston • New York • Baltimore • Pittsburgh
Detroit • Chicago • St. Louis

sent limitations in casting a liquid metallic alloy are multifold and, coupled with the long grinding operations, design latitude has not been great. The use of liquid resin binders, therefore will be of much help. However, the residual magnetism will probably not be as large as with a solid metal. Among other permanently magnetic materials revealed in German production was a special form of ferric oxide, which was applied to a polyvinyl chloride tape. This tape was employed for recording purposes.

New Structures Use Foam

FOAMS: Low density foams with a specific gravity less than 0.1 have continued to receive a great deal of attention. Aside from the polyvinyl chloride foams and those of the polyurethanes revealed in German production, there were no new types which appeared upon the industrial scene in this country. The applications of foamed materials did increase, however, and at least one important development—the true monocoque wing for aircraft—has resulted.

There are two noteworthy trends which will bear watching in the development of plastics foams. One of these embodies the use of reinforcing cloth or paper in a honeycombed crosssection. Pieces of varying thickness may be cut from stock and cemented to a skin of high strength. The same effect can be achieved by using sections of paper-wrapped or plywood tubings, cut to uniform thickness and laid edge to edge between the faces of the sandwich laminate. The other significant trend in plastics foams is performance of the foaming operation in situ. A large machine frame or model of compound curvature which is to be built from sandwich laminate construction would find the adaptation of foams quite costly. When an inner and outer shell forms the body of the part, foaming may be conducted in the space between and the necessary stiffening action attained. Heat and large amounts of catalysts are necessary.

Design Trends

As mentioned previously the Society of the Plastics Industry (SPI) has been instrumental in issuing standards covering the design of inserts for molded plastics parts and design tolerances for various molding compounds. Both of these specifications have been issued in a preliminary form. For the first time the designer has available a store of information which will enable him to establish the correct tolerances for his parts.

Another debatable question which has provoked machine designers for years is the specification of adequate wall thicknesses about metal inserts. This has depended upon whether the material is thermosetting or thermoplastic, the coefficient of expansion of the plastic and the metal, creep tendencies, modulus of elasticity of the plastic, operating temperature range, and other factors. Recommended wall thicknesses for different size inserts now are available in one of the SPI handbooks.

Tolerances for molded plastics parts have been defined in another set of SPI specifications. The designer is urged to follow these standards in laying out parts in molded plastics materials. They reflect the experience of many molders and designers and are offered in such a manner as to aid the proper dimensioning of new plastics parts.

Kodak

It magnifies time...

The Eastman High-Speed Camera provides a direct approach to "high-speed" engineering problems

If you're studying engineering problems that involve action too fast for the human eye to register, you can get the visual facts you need with the Eastman High-Speed Camera, Type III.

Here's what it does . . . It takes motion pictures at 3000 frames a second. Then you project them at only 16 frames a second . . . thus magnifying "action time" almost 200-fold.

Here's what it does for you . . . It enables you to see, analyze, and measure flame phenomena, chatter and vibration in machine elements, movements of fluids. Shows you these and many other types of swift, blurred, transient action as slow, clear, continuous motion.

Don't overlook the possibilities of the Eastman High-Speed Camera, Type III, in your work. To learn more about it and how it may be useful to you . . . write for the new booklet . . . or better yet, if you have access to a 16mm. projector and would like to see some actual examples, ask us to send you our 16mm. demonstration reel of selected high-speed movies.

EASTMAN KODAK COMPANY
Industrial Photographic Division · Rochester 4, N.Y.

High-Speed Movies

. . . another important function of photography

Mail this coupon for new FREE booklet

Eastman Kodak Company
Rochester 4, N. Y.

I want to know more about the Eastman High-Speed Camera, Type III. Please send me your new, free booklet, ☐ your 16mm. demonstration reel of selected examples of high-speed movies. ☐

Name_____
(please print)

Company_____ Dept._____

Street_____

City_____ State_____

19

GEARS *by Fairfield*

—A PLUS VALUE

in any product!

If gears are a component part of the product you sell, there is no finer recommendation for the QUALITY of your product than to be able to say that it is EQUIPPED WITH "FAIRFIELD GEARS." Long producers of the gears needed in high grade trucks and tractors, Fairfield now brings the same standards for gear performance to a wide variety of products.

Get acquainted with Fairfield's engineering and production facilities. Your inquiry will receive prompt attention.

typical products

Fairfield gears are used in all of these classes of equipment . . .

Road Rollers . . . Trucks . . . Sweepers . . . Tractors . . . Power Shovels . . . Printing Presses . . . Aircraft Engines . . . Lathes . . . Grain Combines . . . Mine Hoists . . . Drilling Rigs . . . Rail Cars . . . Diesel Engines . . . Steam Engines . . . Marine Winches.

FAIRFIELD

for FINE GEARS

MANUFACTURING CO.
311 South Earl Avenue
Lafayette Indiana

BUSINESS AND SALES BRIEFS

FORMERLY vice president of Kelly Steel Works Inc., Donald A. MacNeil has joined the sales staff of the forging division of Tube Turns Inc., Louisville, Ky. He will make his headquarters in the Utilities Bldg., 327 South LaSalle St., Chicago.

♦

Change of name has been announced by American Foundry Equipment Co. of Mishawaka, Ind. Henceforth the company will be known as American Wheelabrator & Equipment Corp.

♦

Rhodes Industrial Corp. has been formed recently to engage in the development and manufacture of fine chemicals and synthetic resins. Philip H. Rhodes is president of the new company, which maintains offices and laboratories in East Hampton, N. Y.

♦

Associated with the stainless steel industry for the past seven years, Jay Stranaham has been named sales manager of the Chicago district of Washington Steel Corp., Washington, Pa., an organization specializing in precision cold rolled stainless steel sheet and strip.

♦

Three new appointments in the Meter & Instrument Division of the apparatus department have been announced by General Electric Co. These are: Richard Cutts Jr., assistant manager; E. J. Boland, sales manager for the division's instrument section; and E. J. Wehrle, consultant of the instrument section. Mr. Cutts will also continue to be sales manager of the division's meter section.

♦

With John S. Gulledge in charge as district manager, a new district office has been established in Cincinnati by the Industrial Products Sales Division of The B. F. Goodrich Co. Mr. Gulledge formerly was acting manager of the Denver district and handled special assignments for the Industrial Products Sales Division.

♦

Falk Corp. has named L. H. Billing as district manager of a newly created sales territory which includes Wisconsin, upper Michigan and parts of Iowa. Connected with the company for twenty years, Mr. Billing most recently served as production manager.

♦

Establishment of a branch office at Wilford Bldg., 33rd & Arch Sts., Philadelphia 4, has been announced by Reeves Pulley Co., manufacturer of variable speed control units. The new office will cover the eastern half of Pennsylvania, most of Delaware and Maryland, and the northern tip of Virginia. Philip C. Talbot will serve as manager, assisted by William A. McCosh.

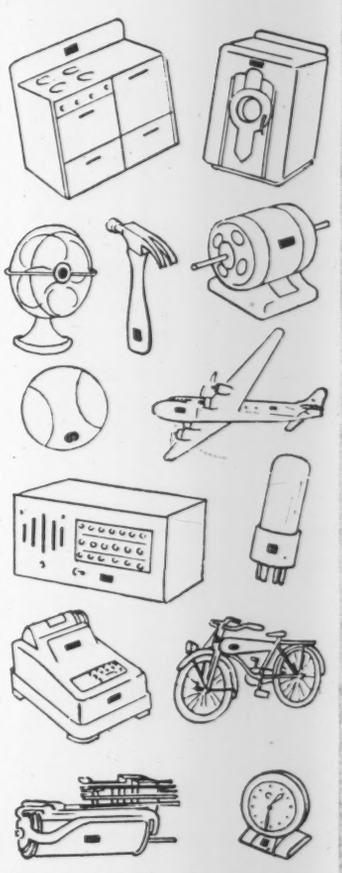
♦

Recent changes among its executive personnel have been made by Shakeproof Inc., a division of Illinois Tool Works. Eugene W. Fuller, division manager, has relinquished his additional position as sales manager to devote his time entirely

Colorful, Durable Nameplates that SELL as they IDENTIFY with MEYERCORD DECALS

NO RIVETS • NO SCREWS
Simple adhesion methods assure durable, colorful product identification

Decals for every product



Conditions under which this "Divine" buffer operates demonstrate Meyercord quality.

Double-duty, low-cost Meyercord Decal nameplates *advertise* as they *identify*. They offer full color for quick brand recognition! Divine Brothers Co., Utica, N.Y., has used them for years as trademarks of colorful distinction on quality buffing wheels. They resist vibration, fumes, moisture, abrasion, acids, wear and constant use.

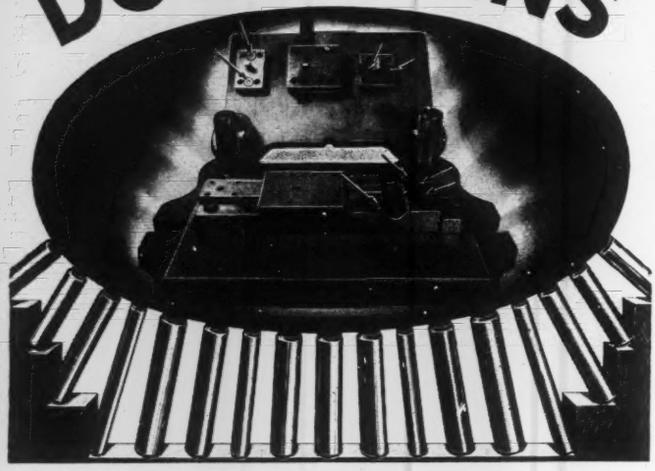
Advertise *your* brand-name for the life of *your* products with tough, flexible Meyercord Decals! They can be applied at production line speeds. No screws, rivets... no sharp edges. Washable, durable! Smooth, lasting adhesion on any commercial surface, curved or flat... even on rubber or crinkle finish. Trademarks, operating or lubrication guides, patent data, etc., can be produced in any size, colors, designs. Learn how Meyercord Decals add more "sell" to nameplates! Write today for free Meyercord Decal Selector... it shows where and how to use Decals. Address Dept. 15-2.

Founder-Member Lithographic Technical Foundation

The MEYERCORD Co.
World's Largest Decal Manufacturer
5323 W. LAKE ST. - - - - - - - - - - - - - - CHICAGO 44, ILL.

ALLEN TRU-GROUND

DOWEL PINS



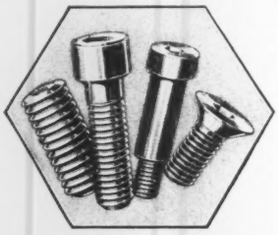
support accurate tool and die work

They serve as locating pins for the diemaker's work — and then go on to general duty as pins and pivots in various machine assemblies. By their accuracy and strength they *retain* precision standards in tool and die assemblies under punishing stresses.

They are ground to a limit of .0002″ over basic size, with an allowable tolerance of plus or minus .0001″. Surfaces are finely polished; subsequently treated with a rust-preventive.

Metallurgically in a class with ALLEN Hex-socket Screws: — made of the same special-analysis *ALLENOY* steel, heat-treated to an extremely hard surface, with a core of the right toughness to prevent "mushrooming" when driven into a tight hole. . . Tensile strength, 240,000 to 250,000 lbs. per sq. inch. . . Typically the Allen high safety-factor in HOLDING-POWER.

Ask your local ALLEN Distributor for samples and dimensional data . . . the same Distributor who serves you dependably with Allen Hex Socket Screws and other first-call mill supply items.



TRADE A MARK

THE ALLEN MANUFACTURING COMPANY

HARTFORD 1, . . . CONNECTICUT, U. S. A.

to the broader efforts of management of the entire Shakeproof organization. B. F. Bales, previously assistant sales manager, has been appointed sales manager. He will co-ordinate sales, field engineering and advertising activities of the division. Russell H. Maude, formerly associated with the automotive phase of Shakeproof, has been named sales manager of the Detroit district to succeed John B. O'Connor who was appointed chief engineer.

♦

Appointment of Arthur E. Jacobs as vice president and sales manager has been announced by Blackmer Pump Co. of Grand Rapids, Mich. Formerly Mr. Jacobs was general sales manager of the Pump Division of George D. Roper Corp., Rockford, Ill.

♦

With John H. Boyd in charge, a new sales engineering office has been opened in Atlanta, Ga., by the Lebanon Steel Foundry of Lebanon, Pa. The new office is located at 17 Edgewood Ave., Northeast, and was established especially to meet the requirements of southern industries for corrosion-resistant, heat-resistant and high-strength alloy and steel castings.

♦

Adoption of the trademark name Flowrator to designate its variable area type flow metering instruments has been announced by Fischer & Porter Co., Hatboro, Pa. Heretofore the trademark name was Rotameter.

♦

Formerly district sales engineer at Chicago, William M. Hufnagel has been named by Link-Belt Co. to serve as district sales manager of the newly opened branch office in the Century Bldg., 808 North Third St., Milwaukee 3. Mr. Hufnagel will be assisted by H. B. Johnson and F. E. Sweeney.

♦

While continuing to serve as director of advertising and sales promotion, C. E. Herington has been appointed manager of the sales engineering department of Meehanite Metal Corp., New Rochelle, N. Y. The sales engineering department was established to provide an advisory engineering service to users of castings and to assist in solving problems involving application, design and sources of supply.

♦

Connected with the company since 1937, Robert A. Wahl has been appointed sales manager of the Union Steel Castings Division of Blaw-Knox Co., Pittsburgh.

♦

McCulloch Motors Corp., formerly known as McCulloch Aviation Inc., has completed its move from Milwaukee to a new plant located adjacent to the Los Angeles airport. The new plant will produce gasoline engines at the rate of more than one a minute.

♦

To serve as its authorized distributor in Hartford and the north central Connecticut area, Carboloy Co. Inc. of Detroit has appointed Silliter-Holden Inc., 433 New Park Ave., Hartford 1, Conn. Fred W. Lauer will act as carbide specialist.

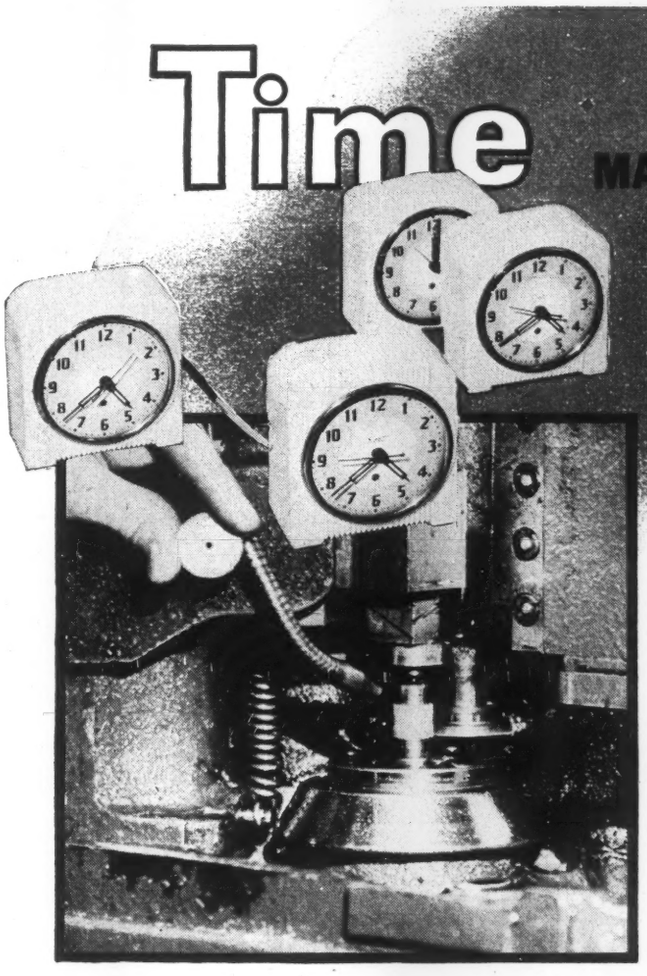
♦

Promotion of R. P. Tripp to executive vice president has been announced by Ohio Forge & Machine Corp., Cleveland. Formerly Mr. Tripp was vice president.

♦

Associated with Bliss & Laughlin Inc. since 1929, James D. MacPherson has been placed in charge as manager of the newly opened district sales office at Room 1303, State Tower Bldg., Syracuse, N. Y. Mr. MacPherson has served in both

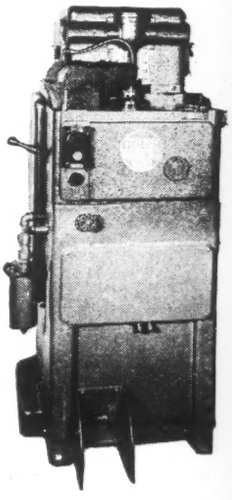
Time MADE QUIET . . . BY PRECISION CLOCK GEARS



Long-wearing and QUIET-operating gears are a sales virtue of well-made Electric Clocks through high-accuracy parts, mass produced on the Fellows Fine-Pitch Gear Shaper.

War-time advancements in the precision generating of fine-pitch instrument gears has been rapidly adapted to the improvement of many products. Modern precision gears of high-involute accuracy—as fine as 64, 80, or even 200 pitch—are contributing substantially to increased serviceability of a variety of products ...clocks, meters, microscopes, motion-picture cameras, and many other precision devices.

Generating precision gears on the Fellows Fine-Pitch Gear Shaper for the Scott Self-Starting Electric Clock at Kurman Electronics Corporation.



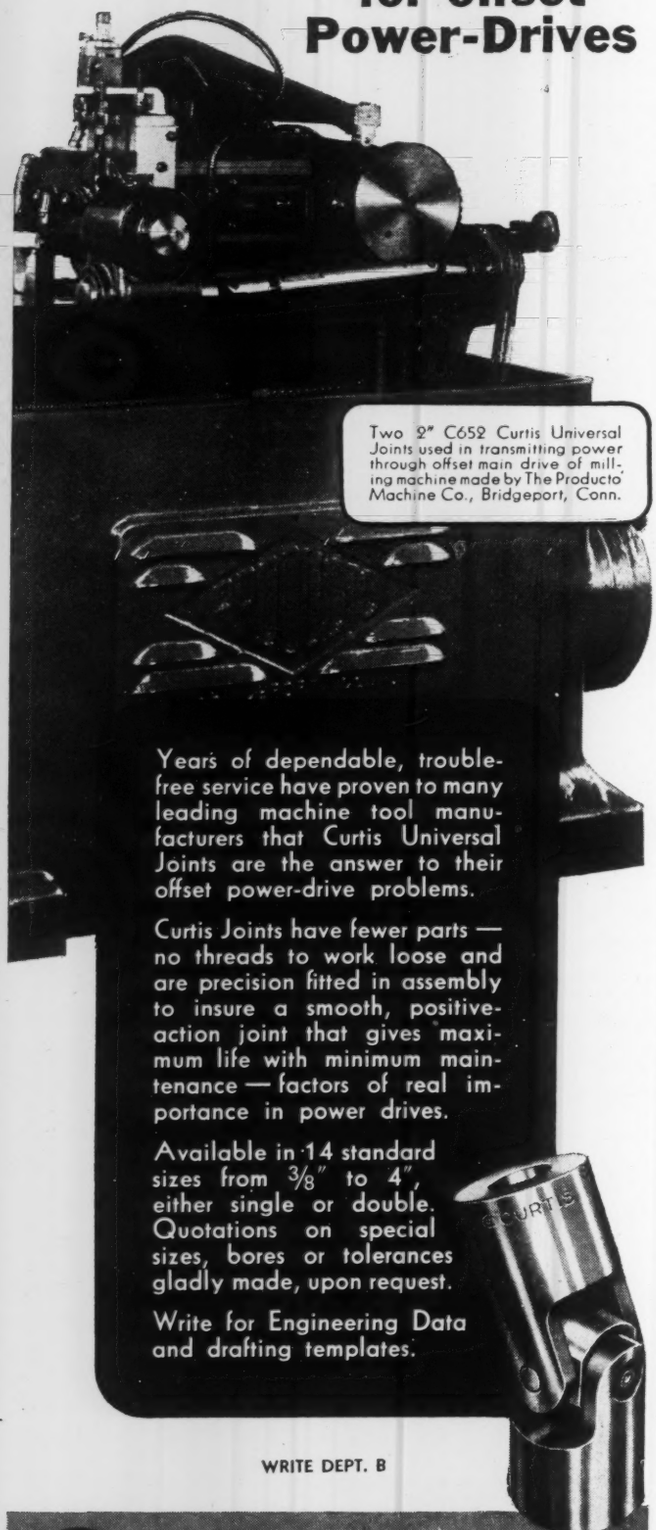
The Fellows Fine-Pitch Gear Shaper has played an important part. With cutter speeds up to 2,000 strokes per minute, and the ganging of blanks on arbors, production rates top those of even sub-press dies. On a cost-per-piece, or tooth precision basis, the Gear Shaper sets new standards. Our Sales Engineers will be glad to show you how Gear Shaper precision will contribute to the salability of your products. Ask for our 64-page illustrated booklet "The Fellows Method". The Fellows Gear Shaper Company, Head Office and Export Department...Springfield, Vermont, U.S.A. Branch Offices...616 Fisher Bldg., Detroit...or 640 West Town Office Bldg., Chicago.

Fellows

THE FELLOWS METHOD...MACHINES AND TOOLS FOR ALL OPERATIONS FROM BLANK TO FINISHED GEAR

EFFICIENT...

for offset Power-Drives



Two 2" C652 Curtis Universal Joints used in transmitting power through offset main drive of milling machine made by The Producto Machine Co., Bridgeport, Conn.

Years of dependable, trouble-free service have proven to many leading machine tool manufacturers that Curtis Universal Joints are the answer to their offset power-drive problems.

Curtis Joints have fewer parts — no threads to work loose and are precision fitted in assembly to insure a smooth, positive-action joint that gives maximum life with minimum maintenance — factors of real importance in power drives.

Available in 14 standard sizes from 3/8" to 4", either single or double. Quotations on special sizes, bores or tolerances gladly made, upon request.

Write for Engineering Data and drafting templates.

WRITE DEPT. B

CURTIS UNIVERSAL JOINT CO. INC. SPRINGFIELD MASS.

the manufacturing and sales departments of the company. Also announced is the appointment of Deppen Kline as Buffalo district sales manager, with headquarters at 110 Hopkins St., Buffalo. Mr. Kline will serve Rochester and surrounding cities.

♦

Formerly assistant general manager, J. T. Myers has been elected vice president in charge of sales and production for the Davey Compressor Co. of Kent, O.

♦

La Salle Steel Co., Chicago 80, has announced the appointment of Theo. S. See as first vice president and general manager and A. Frank Golick as vice president in charge of sales. Both men have been associated with the company for a number of years.

♦

Among recent promotions made by Peterson Steels Inc., New York, are the following: R. G. Willaman, vice president and sales manager; and D. B. Hassinger, secretary and New York district sales manager.

♦

Establishment of a new factory sales office at 3606 Commerce St., Dallas, Tex., has been announced by The Formica Insulation Co. of Cincinnati, manufacturer of laminated plastic materials. Morton F. Harvey, connected with the Chicago sales office for more than twenty years, has been placed in charge as manager of the new Dallas office. Also announced by the company is the return of Edward Brown to the Chicago sales office, which is under the direction of J. A. Healey.

♦

With headquarters at Milwaukee, Lee Mullen has been appointed general manager of sales of Globe Steel Tubes Co. Mr. Mullen has been with the company since 1943 and formerly was associated with Sharon Steel Co., Republic Steel Corp. and Pittsburgh Steel Co.

♦

According to a recent announcement by Celanese Corp. of America, Frank Sanford has been named assistant director of sales of the molding materials department of the Plastics Division.

♦

Storer & Schemm, Transportation Bldg., 307 East Fourth St., Cincinnati 2, O., has been appointed by the Ward Leonard Electric Co. of Mount Vernon, N. Y., to serve as industrial sales representative in southern Ohio, eastern Kentucky, western West Virginia, and the counties of Clark and Floyd in Indiana.

♦

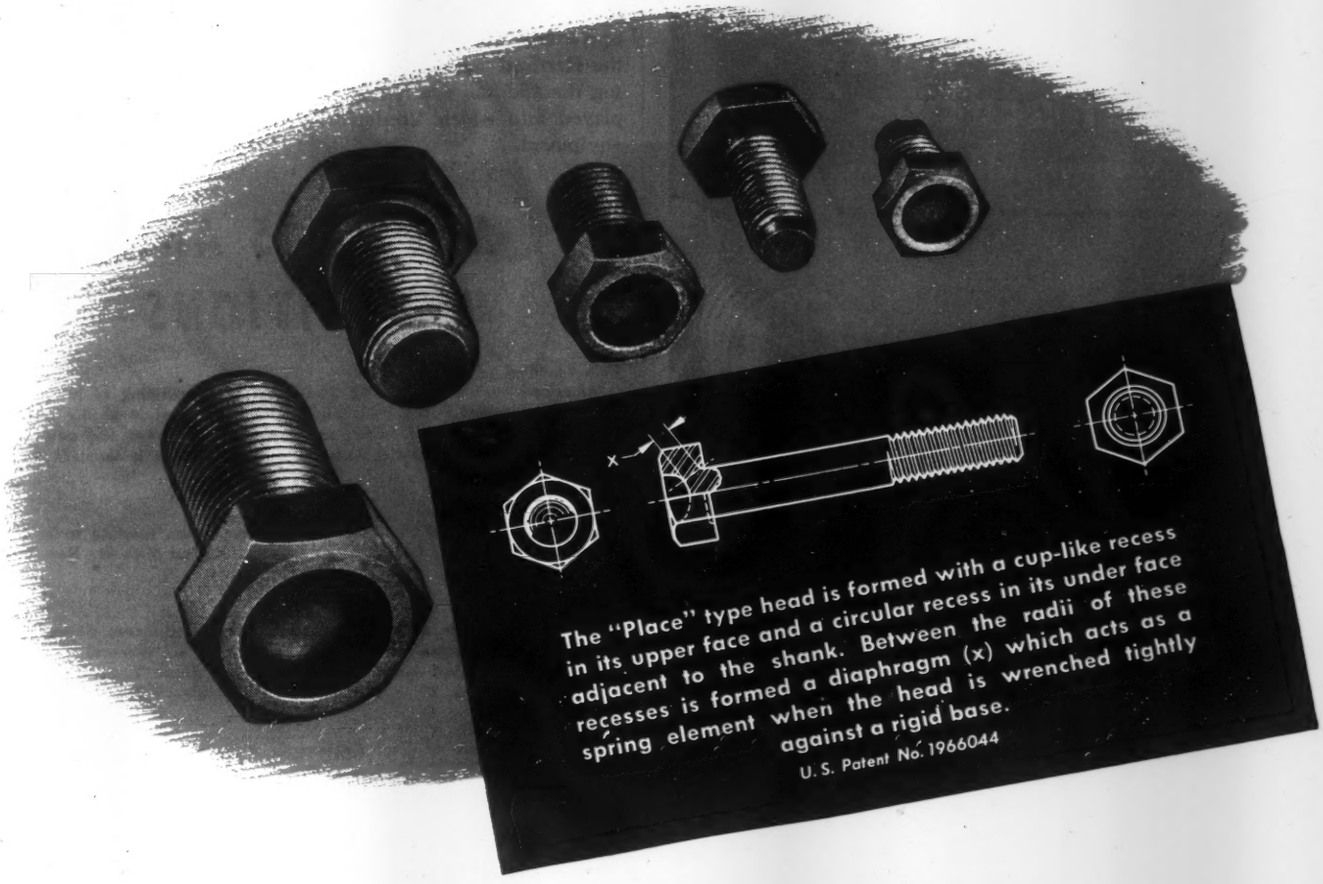
Addition of Charles Wykoff Boll Jr. to its New York staff has been announced by the Udylite Corp. of Detroit. Mr. Boll will operate in Virginia, Maryland, Delaware and part of Pennsylvania.

♦

Connected with Jones & Laughlin Steel Corp. for twenty years, Kier M. Boyd has been made assistant manager of sales of strip and sheet products. Charles Potter has succeeded J. M. Hilbish, who retired recently, as manager of the Pittsburgh warehouse. Prior to his appointment Mr. Potter was associated with the general office of the manager of warehouse sales.

♦

Veeder-Root Inc. has completed a three-story addition to its manufacturing and administrative headquarters at Garden and Sargeant Streets, Hartford, Conn. This new factory build-



SELF-LOCKING "PLACE" BOLTS BY "NATIONAL"

RESIST *vibration and fatigue*

This unique bolt with a "diaphragm" head design — making it elastic and self-locking — was developed for fastening tasks that must include plenty of vibration resistance.

The axial spring tension of the "Place" type bolt head, when tightened to the desired adjustment, has effectively met critical problems of fatigue and involuntary loosening on products of the automotive, aircraft, tractor and many other industries. Important examples—connecting rod bolts, main bearing cap screws, flywheel bolts and piston pin lock screws. These bolts may be used with nuts or in tapped holes but should be used only where it is possible to tighten against a rigid seat.

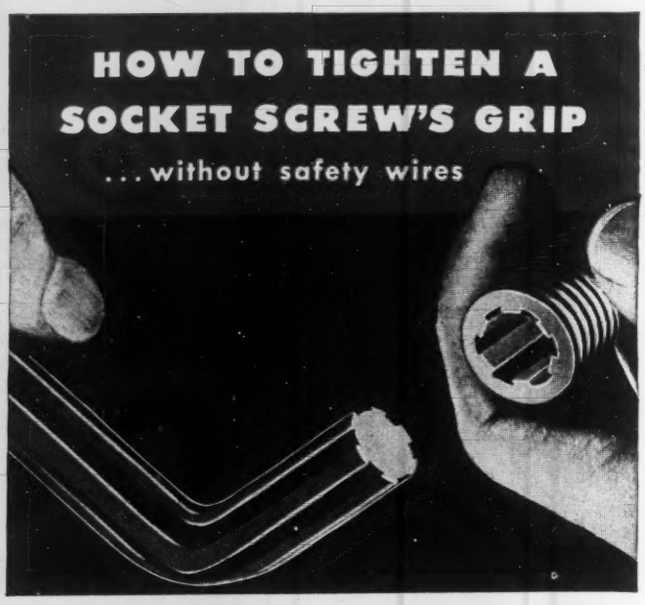
Place bolts are made of alloy steel, heat-treated to high physical properties. They can be furnished in standard cap screw or other bolt dimensions, as well as in special items for specific applications. Write us for detailed information and prices.

National HEADED AND THREADED PRODUCTS

OTHER "NATIONAL SCREW" SPECIALTIES INCLUDE:

Clutch Head Screws
Davis Blind Fasteners
Drake Lock Nuts
Dynamic Lock Nuts
Hi-Shear Rivet Pins & Collars
Huglock Nuts
Laminar Flow Screws
Lok-Thred Studs
Marsden Lock Nuts
Phillips Recessed Screws
Rosan Locking System
Scrivets
Sems

THE NATIONAL SCREW & MFG. CO., CLEVELAND 4, O.



Specify BRISTO "Multiple-Spline"

Defying vibration that often shakes "hex" screws loose . . . speeding assembly of products with hard-to-reach fastening points . . . easing disassembly — BRISTO "Multiple-Spline" Socket Screws are now making a hit with many designers and production men.

BRISTO "Multiple-Spline" gets its tighter grip from the unique way the wrench, geared to the spline-shaped socket, pulls the screw around. No expanding pressure. No bursting or rounding out of socket walls. Yet, a flick of the wrench releases the deep-seated grip.

Literature describing BRISTO "Multiple-Spline" Socket Screws and their many applications is yours for the asking.

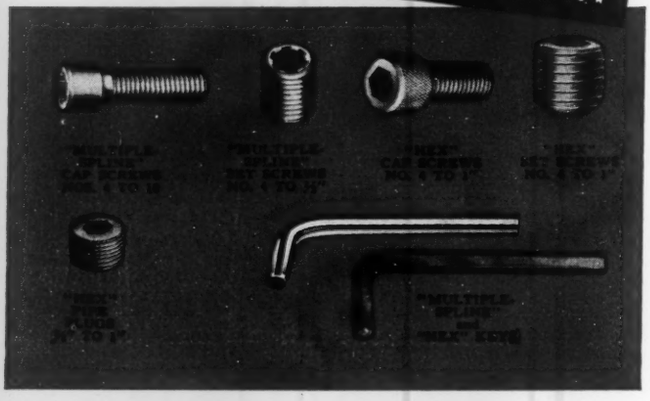
THE BRISTOL COMPANY, Mill Supply Division, 122 Bristol Rd., Waterbury 91, Conn.

WHY "MULTIPLE-SPLINE" MEANS **TIGHTER**

NO EXPANDING PRESSURE: THE KEY PULLS THE SCREW AROUND

Only the "B-LINE" has the right socket screw for every application

The BRISTOL Company
MILL SUPPLY DIVISION



ing adds 40,000 square feet to the company's headquarters operations, bringing the total to 295,000 square feet for both the Hartford and Bristol plants. At an Open House inaugurating the addition nearly a hundred different machines were displayed into which Veeder-Root counters are built as original equipment.

MEETINGS AND EXPOSITIONS

Feb. 24-28—

American Society for Testing Materials. Spring meeting to be held at Benjamin Franklin Hotel, Philadelphia. Technical feature of the meeting will be a symposium on testing and evaluation of paints and paint materials. R. J. Painter, 1916 Race St., Philadelphia 3, is assistant to the secretary.

March 2-5—

American Society of Mechanical Engineers. Spring meeting to be held at Mayo Hotel, Tulsa, Okla. C. E. Davies, 29 West 39th St., New York, is secretary.

March 17-19—

American Institute of Mining & Metallurgical Engineers. Seventy-fifth anniversary celebration and World Conference on Mineral Resources to be held at Waldorf-Astoria Hotel, New York. Frank T. Sisco, 29 West 39th St., New York 18, is secretary of the Metals Division.

March 19-22—

American Society of Tool Engineers. Fifteenth annual convention to be held at Rice Hotel, Houston, Tex. Jno. M Cannon, 1666 Penobscot Bldg., Detroit 26, is director of public relations.

March 22-27—

Fifth Western Metal Congress and Exposition, sponsored by American Society for Metals, to be held in the San Francisco-Oakland Golden Gate area. Technical meetings and industrial exhibits will be at the Oakland Civic Auditoriums. W. H. Eisenman, secretary of the society and managing director of the congress and exposition, will be available for further information at Hotel Leamington, Oakland, Calif.

March 31-April 2—

Midwest Power Conference, sponsored by Illinois Institute of Technology, to be held at Palmer House, Chicago. Professor Stanton E. Winston, Illinois Institute, is conference director.

April 7-10—

National Association of Corrosion Engineers. Annual convention to be held at Palmer House, Chicago. Elton Sterrett, 905 Southern Standard Bldg., Houston 2, Tex., is executive secretary.

April 9-11—

Society of Automotive Engineers Inc. National aeronautic meeting (spring) to be held at Hotel New Yorker, New York. John A. C. Warner, 29 West 39th St., New York 18, is secretary and general manager.

May 6-10—

Second National Plastics Exposition to be held in conjunction with the annual meeting of the Society of the Plastics Industry. Conference headquarters will be at Stevens Hotel, Chicago, and exposition will be at Chicago Coliseum. William T. Cruse, 295 Madison Ave., New York 17, is executive vice president of the society.

May 15-17—

Society for Eperimental Stress Analysis. Annual meeting including a symposium on shock and impact to be held at Stevens Hotel, Chicago. Additional information may be obtained from the society at P.O. Box 168, Cambridge 39, Mass. W. M. Murray is secretary-treasurer.

May 21-24—

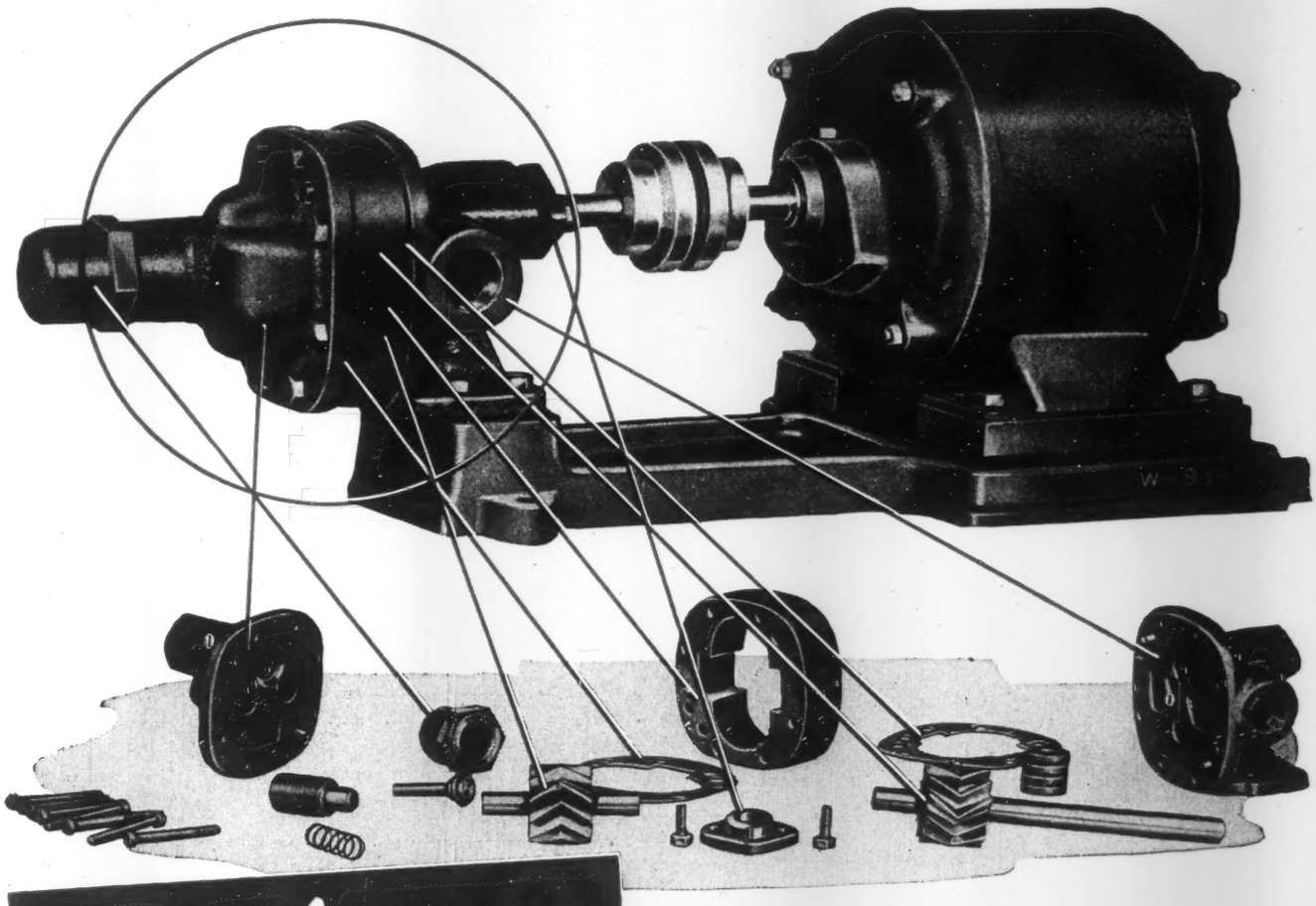
American Society of Mechanical Engineers. Oil and gas power nineteenth national conference to be held at Cleveland. Additional information may be obtained from headquarters of the society at 29 West 39th St., New York. C. E. Davies is secretary.

May 22-31—

Mid-American Exposition to be held at Public Auditorium, Cleveland. Parker Hill, Vice President of the Cleveland Chamber of Commerce, is secretary.

May 26-29—

American Society of Mechanical Engineers. Aviation meeting to be held at Los Angeles. Additional information may be obtained from headquarters of the society at 29 West 39th St., New York. C. E. Davies is secretary.



At Last!

A ROTARY PUMP YOU CAN INSTALL AND FORGET

WORTHINGTON GENERAL SERVICE TYPE GA ROTARY PUMPS *with special herringbone gear rotors*

It's the simplicity of these small-capacity rotary pumps that contains the promise of long, trouble-free service-years ahead. Only a few moving parts; quiet, efficient herringbone gears; four large, pressure-lubricated bearings. That's all there is to this simple design . . . the answer to what, Worthington Market Research discovered, you and men like you in many industries really want.

Subject Worthington GA Rotary Pumps to the test. You will find they will stand up under severe conditions . . . will show little wear when inspection or maintenance time rolls around.

For full specification and application data that prove *there's more worth in Worthington,* ask your nearby Worthington Distributor or Representative for Bulletin W-484-B1 . . . or write direct. *Worthington Pump and Machinery Corporation, Merchandising Division, Harrison, N. J. 36 District Offices throughout the U. S.*

WORTHINGTON

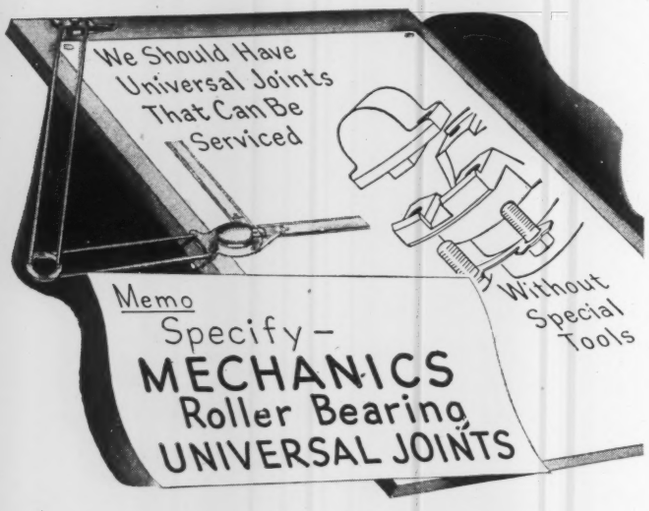
86-44

PRODUCTS BASED ON MARKET RESEARCH

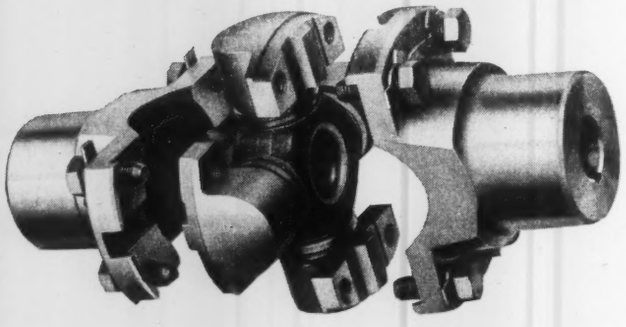
Centrifugal Pumps | Rotary Pumps | Steam & Power Pumps | Liquid Meters | Vertical & Horizontal Compressors | Multi-V-Drives | Variable Speed Drives

What Would You Do About A Problem Such As This?

INTER-OFFICE MEMO:
Let's get universal joints for our 194X model that can be serviced on the road—without special tools



Unique features of MECHANICS Roller Bearing UNIVERSAL JOINTS make them unusually easy to install and service. The complete cross and bearing assembly can be removed simply by taking out the cap screws and separating the end yokes slightly. No flange is required for drive connections. Accurately and durably built for long, heavy service, MECHANICS Roller Bearing UNIVERSAL JOINTS are inherently balanced for smooth operation.



Let our engineers show you how MECHANICS close-coupled Roller Bearing UNIVERSAL JOINTS conserve space and compensate for offset shafts, in your new and improved models.

MECHANICS UNIVERSAL JOINT DIVISION
Borg-Warner • 2026 Harrison Ave., Rockford, Ill.

NEW MACHINES

And the Companies Behind Them

Automotive

37-passenger intercity bus, Twin Coach Co., Kent, O.
Low-height, mobile service station unit, The Buda Co., Harvey, Ill.
Electronic spark plug analyzer, Rowe Radio Research Laboratory, Chicago 39.

Business

12-station electronic intercommunicating unit, Executone Inc., New York 17.
Deluxe intercommunicating systems, Talk-A-Phone Co., Chicago.

Cleaning

Controlled cool air vapor degreaser, Mabor Co., Rahway, N. J.

Construction

Concrete pouring machine, The Johnson & Thomas Machine Works, Los Angeles.
Diesel tractor, Allis-Chalmers Mfg. Co., Tractor Div., Milwaukee 1.
Heavy-duty hammer mill, Buffalo Hammer Mill Corp., Buffalo 3.

Domestic

5 cubic foot freezing and storing unit, Orley Freezers Inc., Detroit.
Gas and electric ranges, Crosley Corp., Cincinnati.
Mahogany mantel clocks, deluxe alarm clocks, and kitchen clock and timer combination, General Electric Co., Bridgeport 2, Conn.
Automatic home disposal unit, Calcinator Div., Valley Welding & Boiler Co., Bay City, Mich.

Dry Cleaning

Steam finishing board, E. L. Chrisman Co., Los Angeles.
Synthetic dry cleaner, Shields Engrg. & Mfg. Co., Cleveland 10.

Finishing

Electropolisher for metallurgical specimens, Buehler Ltd., Chicago 1.
Pantographic diamond farm wheel dresser, Moore Special Tool Co., Bridgeport, Conn.
Continuous pickling and washing spray-type machine, The B. F. Goodrich Co., Akron, O.
Midget size finishing and deburring machine, Sturgis Products Co., Sturgis, Mich.

Laboratory

Ferrograph for checking composition and condition of ferromagnetic materials, Allen B. du Mont & Laboratories Inc., Passaic, N. J.
Box furnace for high automatically controlled temperatures, General Electric Co., Schenectady, N. Y.

Materials Handling

28-50 inch hydraulic elevating table, Lyon-Raymond Corp., Greene, N. Y.
Lightweight, rear-drive, low-lift power trucks, The Elwell-Parker Electric Co., Cleveland.
4000 lb. fork-type lift truck, Hyster Co., Portland, Oreg.
Plastic and rubber extruding unit conveyor, Island Equipment Corp., New York 17.
Motor-generator charger for motorized lift truck batteries, Hertner Electric Co., Cleveland.
Fork type power truck for elevation of 18 feet, Elwell-Parker Electric Co., Cleveland.

Printing

Magazine printing presses, R. Hoe & Co. Inc., New York 54.

Railroad

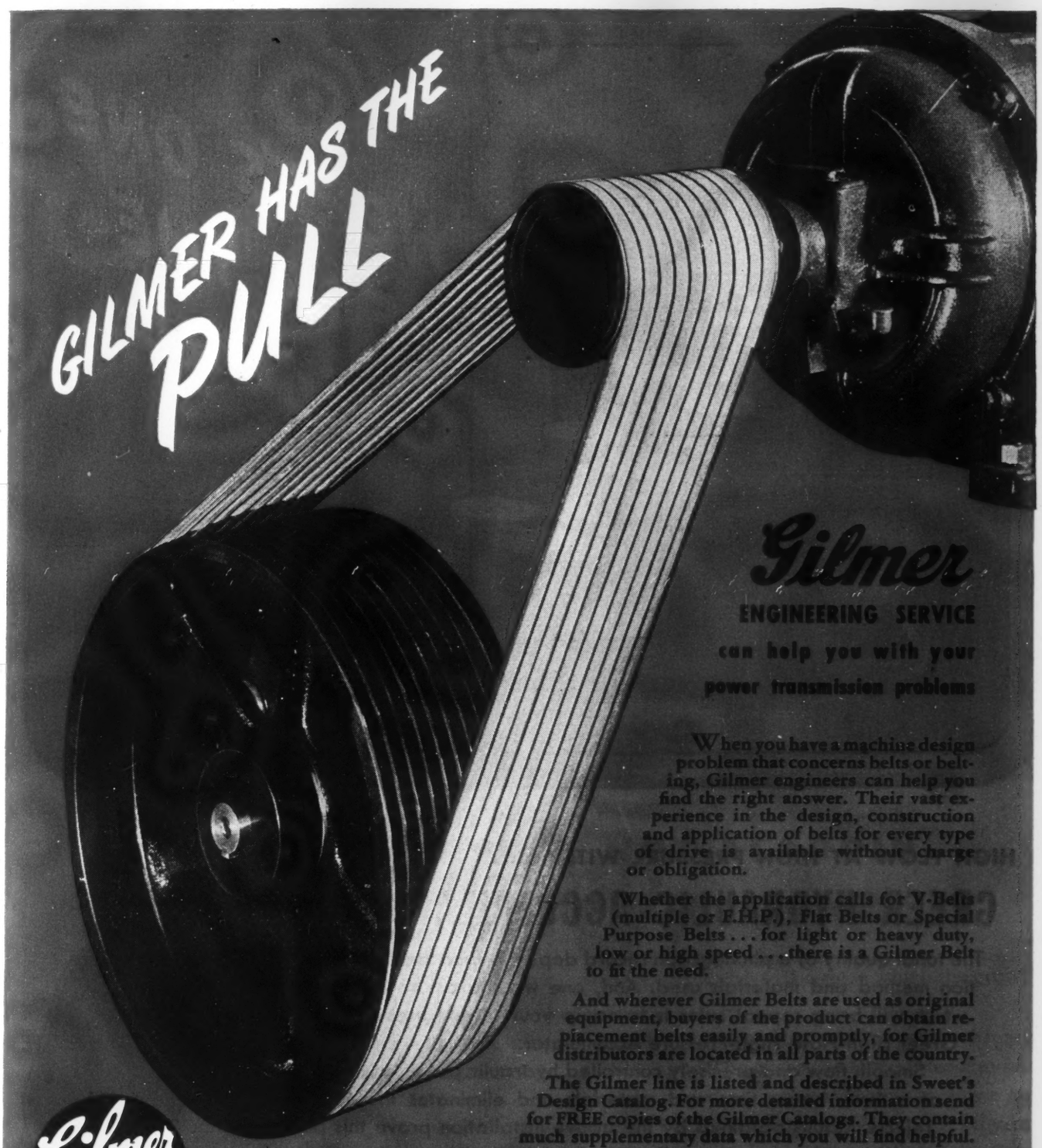
Electric drinking water cooler, Westinghouse Electric Corp., Pittsburgh.

Restaurant

Automatic fryers and griddles, Walter & Carrell Mfg. Co., Denver 5.

Testing

Gear testers with 15-inch capacity, The George Scherr Co., New York 12.
Strain gage amplifier, G. C. Wilson & Co., Chatham, N. Y.
Aircraft vacuum pump test machine, Greer Hydraulics Inc., Brooklyn 15.
Low-range tester for light materials and small finished items, W. C. Dillon & Co., Chicago 44.
Core loss tester, General Electric Co., Schenectady, N. Y.
Surface analyzer, The Brush Development Co., Cleveland 14.
Testing machine for walkway materials, Tinius Olsen Testing Machine Co., Philadelphia 23.
10,000 pound hydraulic transverse testing machine, Steel City Testing Laboratories, Detroit 4.
Internal measuring instrument for checking small rings, Sheffield Corp., Dayton, O.
Torsion testing machine, Sonntag Scientific Corp., Greenwich, Conn.
Electronic test unit, Sylvania Electric Products Inc., New York 18.
Ac bridges for measuring the power factor and capacitance, General Electric Co., Schenectady 5, N. Y.
Vacuum leak detector, Consolidated Engineering Corp., Pasadena, Calif.
Spectrophotometer for color matching, General Electric Co., Schenectady, N. Y.



Gilmer

ENGINEERING SERVICE

can help you with your power transmission problems

When you have a machine design problem that concerns belts or belting, Gilmer engineers can help you find the right answer. Their vast experience in the design, construction and application of belts for every type of drive is available without charge or obligation.

Whether the application calls for V-Belts (multiple or F.H.P.), Flat Belts or Special Purpose Belts . . . for light or heavy duty, low or high speed . . . there is a Gilmer Belt to fit the need.

And wherever Gilmer Belts are used as original equipment, buyers of the product can obtain replacement belts easily and promptly, for Gilmer distributors are located in all parts of the country.

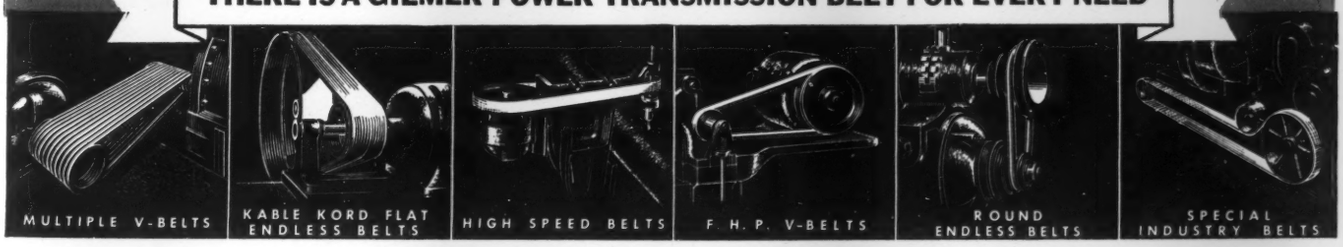
The Gilmer line is listed and described in Sweet's Design Catalog. For more detailed information send for FREE copies of the Gilmer Catalogs. They contain much supplementary data which you will find helpful.

L. H. GILMER COMPANY, Tacony, Philadelphia 35, Pa.

Division of United States Rubber Company

Gilmer BELTS

THERE IS A GILMER POWER TRANSMISSION BELT FOR EVERY NEED



HIGH FLOW AT HIGH PRESSURE WITH . . .

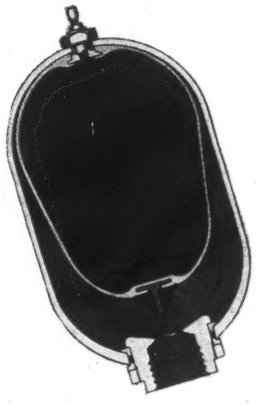
GREER HYDRAULIC ACCUMULATORS

The tonal quality of a phonograph record depends upon the production method and materials used. And, one way to assure records which will bring repeat sales is to equip your record press with a Greer High-Flow, High-Pressure Accumulator.

Smooth flow and precisely controlled hydraulic power at the flick of a lever saves time and materials and eliminates those costly rejects. Results obtained by the above installation prove this point.

In countless other applications in practically every variety of industrial processes, Greer Accumulators are increasing the efficiency and dependability of production, tools, and machines.

Get the complete story now! Write for bulletin "Accumulators for Industry"



"PATENT OLAER NUMBER 2256835" "PATENT APPLICATION OLAER SERIAL NUMBER, 519782."

GREER HYDRAULICS INC.
454 EIGHTEENTH STREET, BROOKLYN 15, N. Y.

IT WAS EDISON, NOT ALADDIN WHO REALLY HAD THE LAMP!

"ALADDIN'S LAMP" made good reading but gave little illumination to a light-hungry world. It was the tiny glow of Edison's incandescent lamp that expanded into the radiance which floods the globe.

Hard on the heels of Edison's invention came the need for transmitting electricity, economically, over long distances. Thus, the development of alternating current in the 1880's enabled this young nation to set the pace in the whole realm of electricity. For here was an economical means of transmitting electrical energy at high voltages and with low losses—not only for light, but also for the heat and power on which the growth of industry thrived.

Then, as now, electricity and copper were inseparable... and The American Brass Company was already a leading supplier of copper, brass and bronze. Today, with more than a hundred years of manufacturing experience behind it, this Company continues its help in working out many of the metal problems peculiar to the electrical equipment and appliance industries... and to the fields of electric power generation, distribution and control.

46161

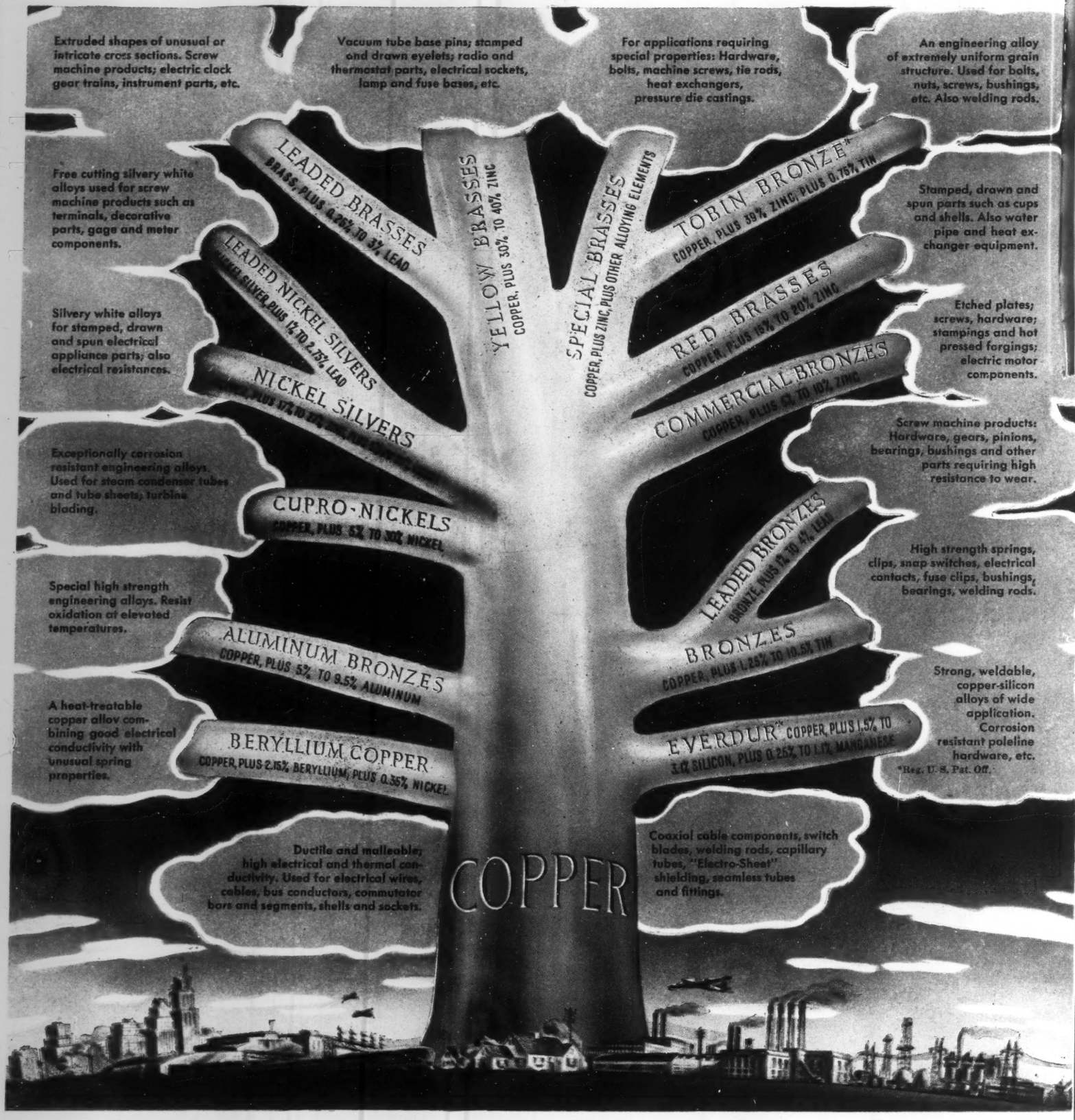
THE AMERICAN BRASS COMPANY
***General Offices:* Waterbury 88, Connecticut**

ANACONDA
from mine to consumer

Anaconda Copper & Copper Alloys

In the Electrical Industry

Nothing serves like Copper and its Alloys



ANACONDA
from mine to consumer
REG. U.S. PAT. OFF.

Made by THE AMERICAN BRASS COMPANY

General Offices: Waterbury 88, Connecticut • Subsidiary of Anaconda Copper Mining Company

In Canada: ANACONDA AMERICAN BRASS LTD., *New Toronto, Ont.*

skilled springmakers . .
AND practical,
experienced engineers,
SPECIALISTS
in spring design
and manufacture
At Accurate

It takes people to make springs. Ours are specialized, highly trained, long-experienced people—well qualified to give you the finest in spring craftsmanship.

¶ Our engineers too, are an important reason why you'll like Accurate Spring Service. They're old hands at spring-making . . . they've developed manufacturing systems and procedures that enable us to handle your jobs with the greatest speed and efficiency. These Accurate engineers are at your service on spring design problems. You will benefit from their practical assistance in designing exactly the right spring for your application.

¶ Why not try Accurate on your next job.

Send for your copy of the new Accurate Spring Handbook. It's full of data and formulae which you will find useful. No obligation of course.

ACCURATE SPRING MFG. CO.
3813 W. Lake Street Chicago 24, Illinois

Accurate Springs

SPRINGS WIREFORMS • STAMPINGS

THE ENGINEERING "KNOW-HOW" IS IN THE PACKAGE, TOO!

A Federal Ball Bearing's long, friction-free life is equal to the sum of these parts:

1. Balls uniformly spherical within .000025"...not varying in diameter more than .00005" in any bearing.
2. Through-hardened races concentric with each other to prevent run-out—whatever the r.p.m.
3. Sides of rings parallel to each other and the ball track.
4. Ball tracks ground to chatter-free finish and just the right radius.
5. Bores cylindrical, not tapered or bellmouthed.

Add to these the vital "component"—Federal engineering "know-how"—which goes into every bearing assembly—and you complete this precision package.

50 years of living with bearing problems—manufacture and application both—will be brought to bear in solving your particular bearing need when you consult Federal. And Federal can draw upon its complete line of ball bearings—in every range and size—to suit your requirements.

Now is a good time to get acquainted with our representative nearest to you.

THE FEDERAL BEARINGS CO., INC. • POUGHKEEPSIE, NEW YORK

Makers of Fine Ball Bearings

REPRESENTATIVES LOCATED AT

Detroit: 2640 Book Tower—26 • Cleveland: 402 Swetland Building—15
Chicago: 8 S. Michigan Ave.—3 • Los Angeles: 5410 Wilshire Blvd.—36

FEDERAL BALL BEARINGS

ONE OF AMERICA'S LEADING BALL BEARING MANUFACTURERS

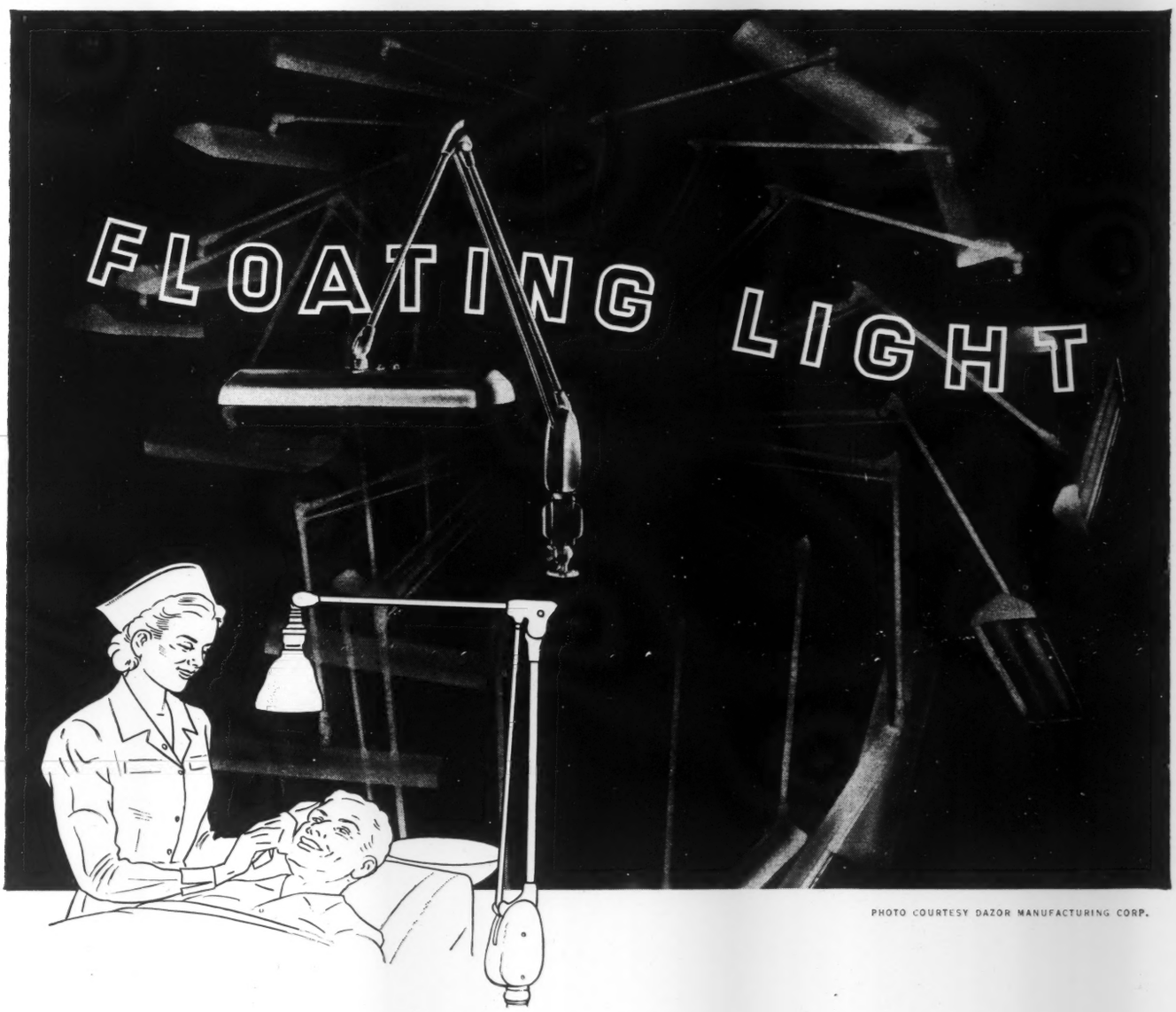


PHOTO COURTESY DAZOR MANUFACTURING CORP.

Localized lighting, "floated" into position as easily and quickly as you move your arm! Push, pull, raise or lower it . . . swing, turn or tilt it . . . the Dazor fluorescent or incandescent lamp "freezes" into position instantly, without tightening or locking.

The double arms of these ingenious floating lamps—and the vertical section of the pedestal models—are built of OSTUCO Steel Tubing, selected for its strength-without-weight advantages. Here, as in countless other applications, OSTUCO research, testing, design and manufacture have combined to solve a complex manufacturing problem.

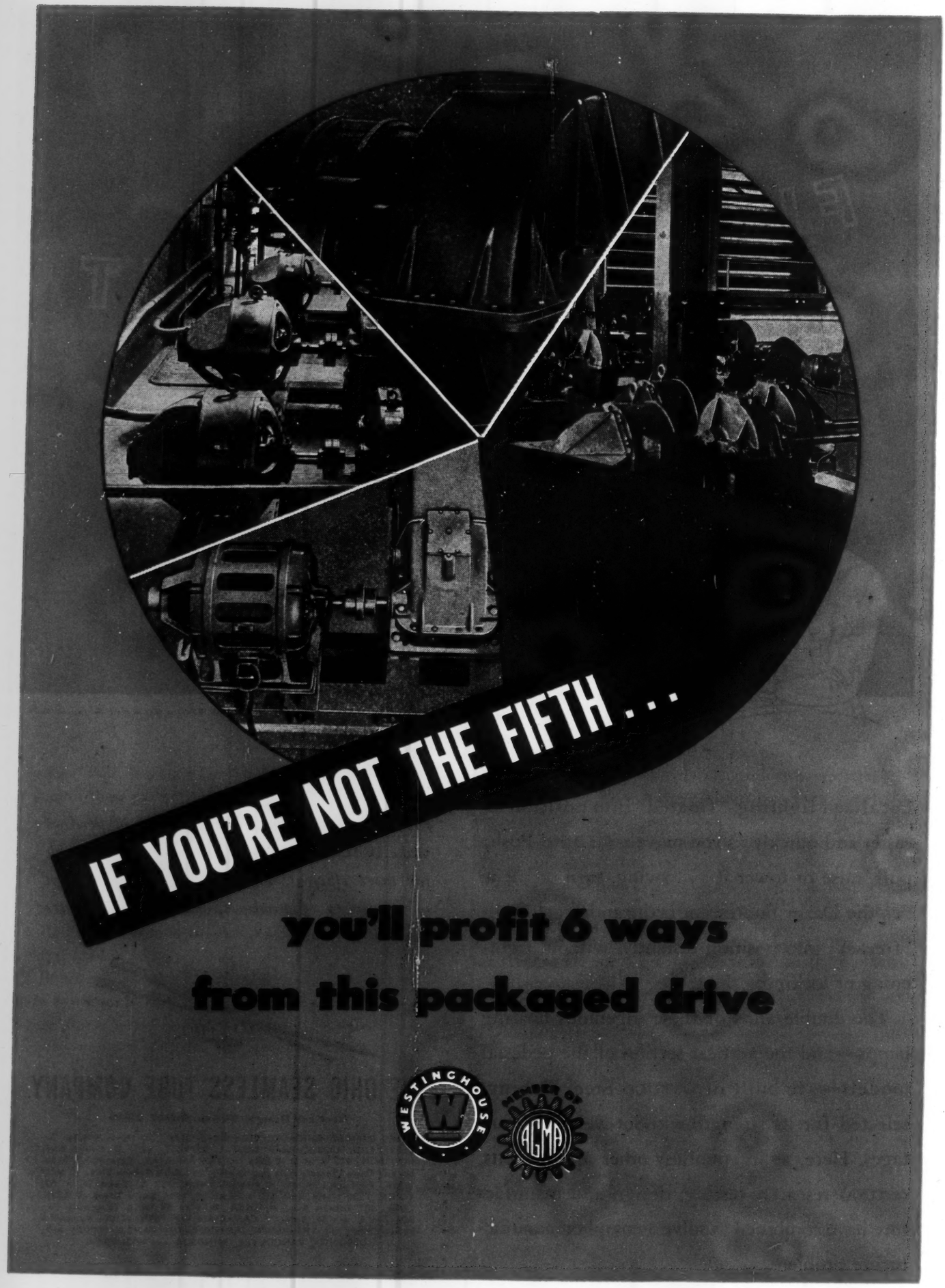
Precision craftsmanship and quality of product make OSTUCO a welcome partner in the search for more efficient, more economical production of a variety of products, many of which are similar to yours.

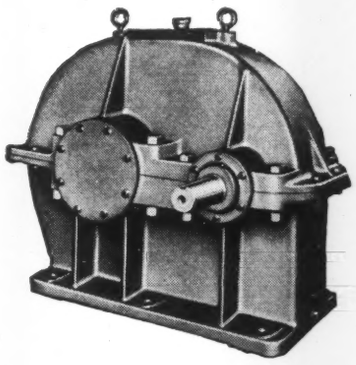
OSTUCO

THE OHIO SEAMLESS TUBE COMPANY

***Plant and General Offices:* SHELBY, OHIO**

SALES OFFICES: CHICAGO, Civic Opera Bldg., 20 North Wacker Dr. CLEVELAND, 1328 Citizens' Bldg. • DETROIT, 2857 E. Grand Blvd. HOUSTON, 927 A M & M Bldg. • LOS ANGELES, Suite 200-170 So. Beverly Drive, Beverly Hills • MOLINE, 225 Fifth Avenue Bldg. • NEW YORK, 70 East 45th St. • PHILADELPHIA, 123 S. Broad St. • ST. LOUIS, 1230 North Main St. • SEATTLE, 1911 Smith Tower • SYRACUSE, 501 Roberts Ave. • TULSA, Refining Engine & Equipment Co., 604 Ten E. 4th St. Bldg. • CANADIAN REPRESENTATIVE: Railway & Power Corp., Ltd., HAMILTON, MONTREAL, NORANDA, NORTH BAY, TORONTO, VANCOUVER, WINDSOR and WINNIPEG.


IF YOU'RE NOT THE FIFTH . . .
you'll profit 6 ways
from this packaged drive
WESTINGHOUSE
MEMBER OF
AGMA



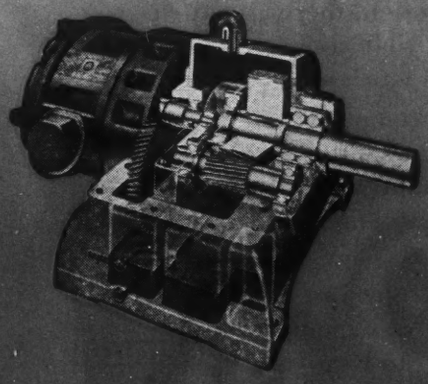
This Type SH speed reducer is a single-reduction unit which is furnished in thirteen standard ratios in each of twelve sizes. The Type DH speed reducer, which is a double-reduction unit, is offered in fifteen standard ratios in each of twelve sizes.

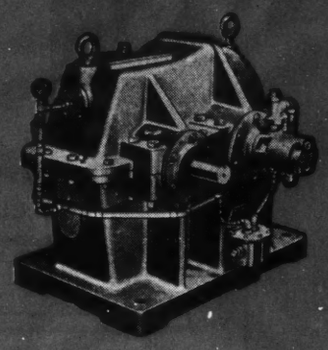
Because 4 out of 5 machines operate at slower speeds than their prime movers supply, you stand to gain six ways when you put Westinghouse speed reducers to work for you:

1. You step up power efficiency (one plant raised it from 80.9% to 85.4%).
2. You reduce frequent servicing of open-type drives to semi-annual lubrication of a packaged unit.
3. Maintain positive alignment of drive and driven machine.
4. Long service life through single helical gearing heat-treated by the exclusive Westinghouse BPT process.
5. Minimum power loss with anti-friction bearings.
6. Precision operation from hob-cut gears.

For drives up to 1,000 hp, you have your choice of twenty-four sizes of Westinghouse speed reducers—Types SH and DH—for speed reduction ratios from 2.82 to 70.5 . . . and you get all the benefits of unit responsibility with motor and gears supplied by one manufacturer.

Get all the facts today from your nearest Westinghouse office on the advantages you'll gain when you use these matched unit drives for all types of speed reduction. Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-07252





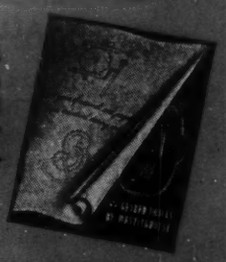
FOR DRIVES FROM 1 TO 75 HP CHOOSE GEARMOTORS

These efficient, economical gearmotors give you the best in modern speed reduction for drives from 1 to 75 hp. Easy to install, simple to service and adaptable for all types of drives and motors. Three types—A, C and E—are available and provide output speeds of 1,450 to 16.5 rpm. All unit types can be used with either single-phase, polyphase or d-c motors.

FOR DRIVES UP TO 2,000 HP AND 9,000 RPM USE THESE SPEED INCREASERS

These matched-unit drives have special advantages for all industrial and commercial high-speed jobs up to 2,000 hp and 9,000 rpm. Units are available in 30 sizes with gear ratios of 1.25 to 3.25 up to 2 to 12.

The whole story of industrial geared drives and the way every industry is using them is told in this new book, profusely illustrated with actual applications. Ask for your copy of B-3730 today, on your business letterhead, please.



Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

4 out of 5 drives need speed reduction

Just off the Press...

New reference book on Aluminum Alloys and Mill Products

FOR design engineers, production men, and purchasing agents, this new reference book brings invaluable data on aluminum.

It contains 248 pages, 106 tables, 20 photographs, chock-full of specific facts about Aluminum Alloys and Aluminum Mill Products.

The information is arranged according to type of product...sheet and plate; extruded shapes: roll-formed shapes; tubing and pipe; wire, rod and bar; forging stock; press forgings; ingot metal for sand casting, permanent mold casting and die casting. For each product, the book shows alloys and tempers, bend radii (for sheet), pressure calculations (for tubing), manufacturing methods, annealing and heat-treating cycles, weights, size and tolerance ranges, chemical compositions. It also covers physical and mechanical properties including densities, coefficients of expansion, thermal and electrical conductivities, yield and ultimate strengths, hardnesses and much other information.

This reference book on aluminum is the latest of several authoritative handbooks about aluminum recently published by Reynolds. You will find them all immensely valuable.

To get your copy, just fill out the coupon below with check or money order and mail to Reynolds Metals Company, Louisville 1, Kentucky.

REYNOLDS ALUMINUM

"MACHINING ALUMINUM ALLOYS"

124 pages packed with practical up-to-date facts about machining aluminum alloys. Eight double-page charts of easily usable data on tooling, speeds and feeds for eight important types of machine operations. Price: $1.00

"WELDING ALUMINUM"

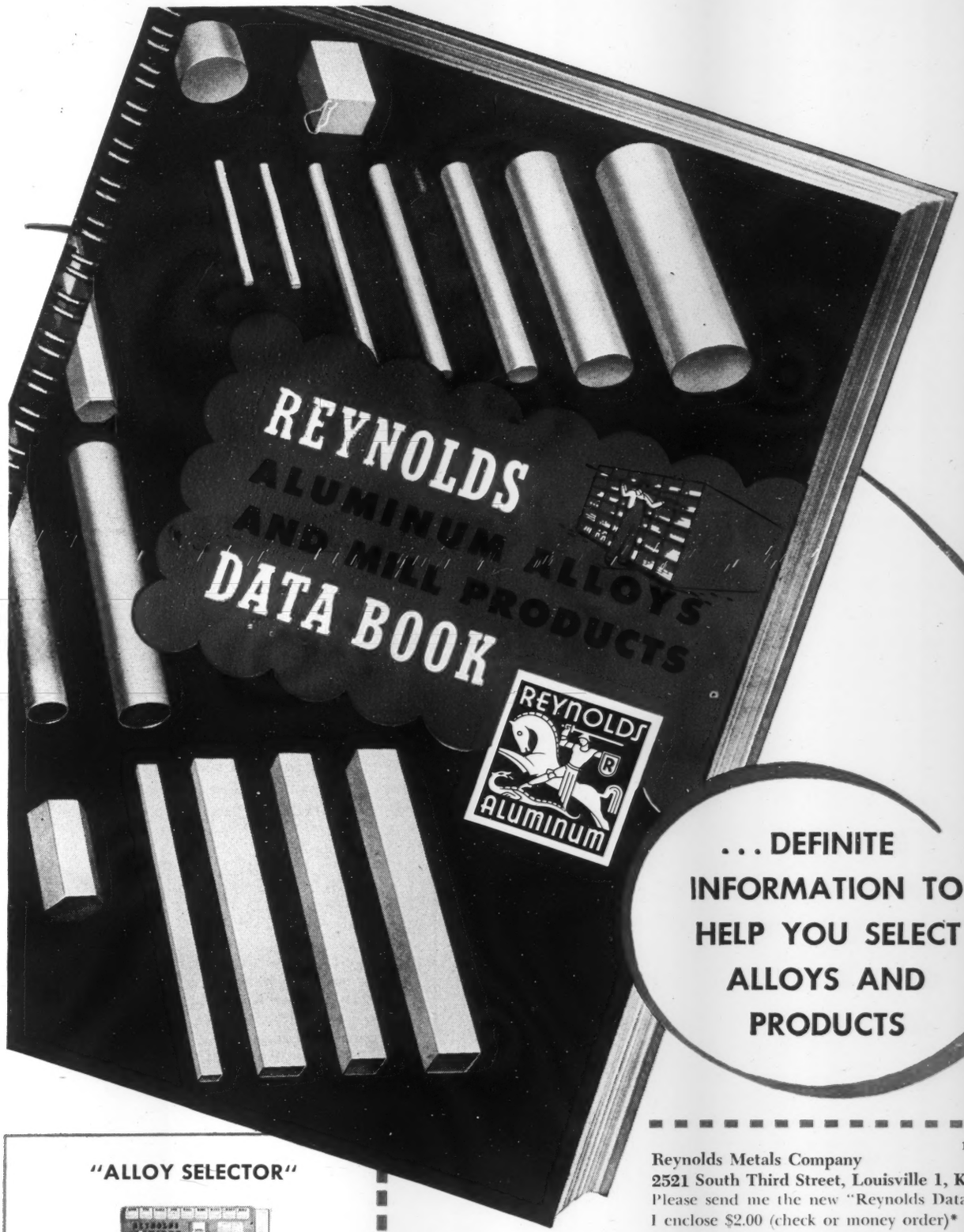
A new handbook on aluminum welding gives detailed information on 11 aluminum welding processes thru all stages from edge preparation to finishing. Fully illustrated with photographs, charts and tables. Price: $1.00

"METALS WEIGHT CALCULATOR"

One of the handiest metal weight calculating devices ever developed...simple...accurate ...fast. Calculates weights of aluminum, magnesium, steel, brass, copper, and nickel. Only $.50

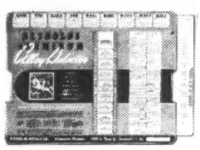
"HEAT-TREATING ALUMINUM ALLOYS"

The "What, Why and How" of the metallurgy and heat treatment of all types of aluminum alloys written for both the non-technical man and the highly trained technician. Tables, illustrations and charts cover 96 different alloys and tempers. Price: $1.00



. . . DEFINITE INFORMATION TO HELP YOU SELECT ALLOYS AND PRODUCTS

"ALLOY SELECTOR"



Just two settings to place at your finger tips the mechanical properties, chemical compositions, physical constants, thermal treatments, and specification numbers of 18 aluminum alloys. Price: $1.00

1576-A1-2A

Reynolds Metals Company
2521 South Third Street, Louisville 1, Kentucky
Please send me the new "Reynolds Data Book." I enclose $2.00 (check or money order)* to cover the cost of printing and mailing.

Name _____ Title _____

Company _____ Address _____

City _____ Zone _____ State _____

( ) Please send me a copy of "Heat Treating Alloys." I enclose $1.00
( ) Please send me a copy of "Machining Aluminum Alloys." I enclose $1.00
( ) Please send me a copy of "Welding Aluminum." I enclose $1.00
( ) Please send me a Reynolds Aluminum Alloy Selector. I enclose $1.00
( ) Please send me a Reynolds Metals Weight Calculator. 1 enclose 50 cents

PLEASE PRINT OR TYPE CAREFULLY

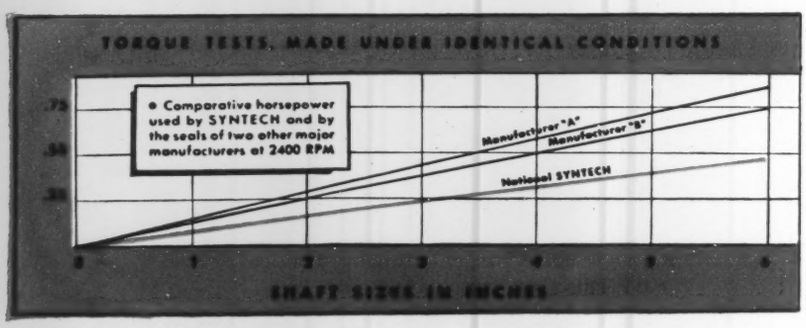
* Please do not send purchase orders, cash or stamps.

Syntech* the New National Oil Seal which doubles seal life, cuts power loss, maintains zero leakage

THE revolutionary new sealing member of synthetic rubber in these new National SYNTECH Oil Seals insures optimum sealing results with marked reduction in power consumption (see Chart below).

Dynamometer and road tests give positive proof that SYNTECH'S safety factors on speed, runout, abrasion and wear far surpass any other seal tested. These same tests show conclusively that National SYNTECHS perform at zero leakage over periods up to 10 times the life of a normal application.

Write today to National for more information and samples of the great new National SYNTECH Oil Seal.

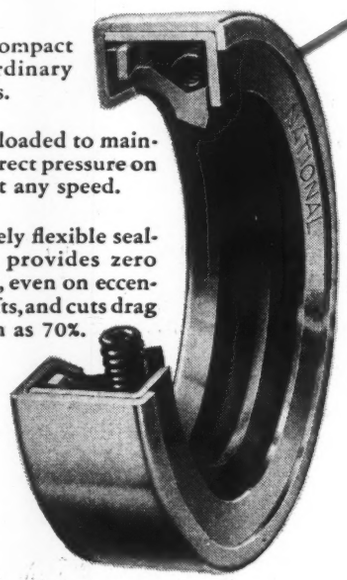


***SYNTECH** (trademark registered) is an entirely new oil seal which utilizes a special National-developed, synthetic-rubber sealing member.

1 More compact than ordinary oil seals.

2 Spring-loaded to maintain correct pressure on shafts at any speed.

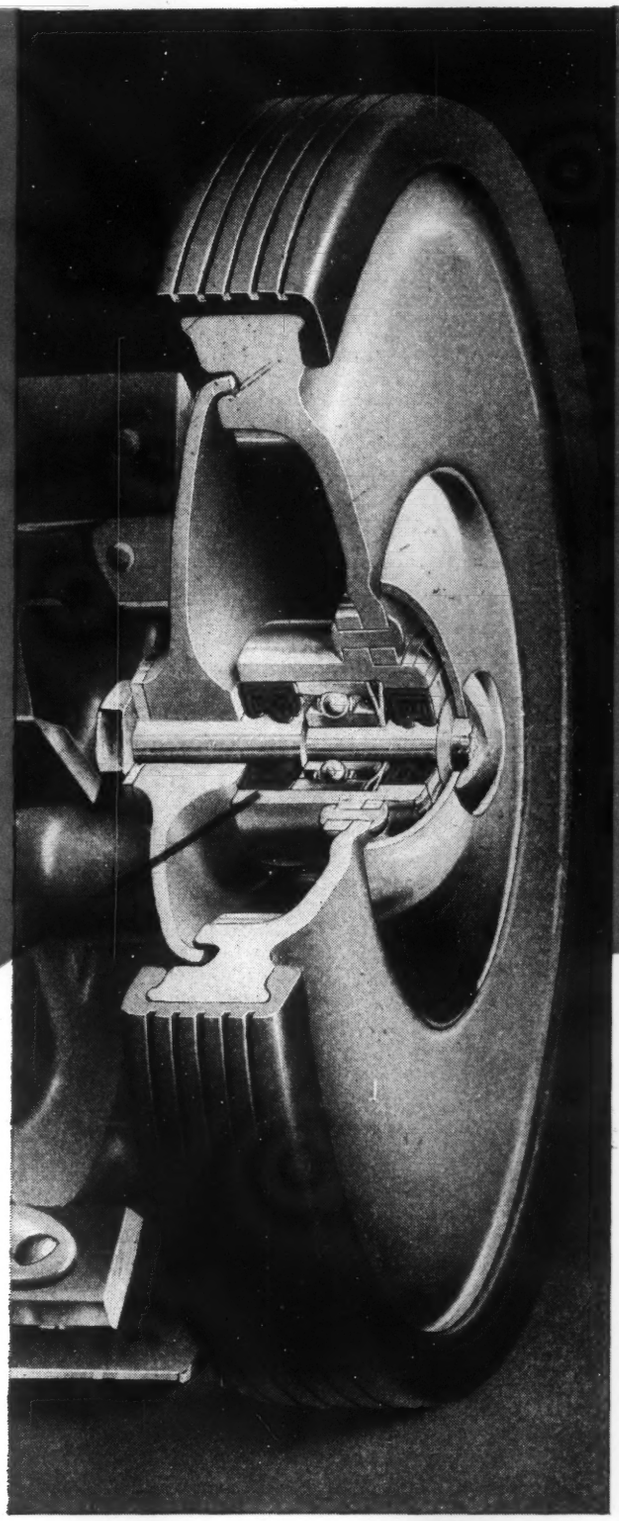
3 Extremely flexible sealing lip provides zero leakage, even on eccentric shafts, and cuts drag as much as 70%.



SYNTECH is made of synthetic rubber compounded to achieve high flexibility and low coefficient of friction.

Design of sealing lip provides limited shaft contact.

This thin section assures maximum flexibility of the sealing member.



Syntech Seals

reduce drag 70%, give 100% longer life at zero leakage in this lawn mower application...

The push resistance of lawn mowers is greatly reduced by use of friction-free bearings. In order to make their use practical, oil seals are required.

Exhaustive tests were held and ultimately four prominent manufacturers turned to National SYNTECH Oil Seals. The installation of FOUR SYNTECHS provided a 100% lubricant seal for the estimated life of the mower, without adding any noticeable drag.

Whether for lawn mowers or battleships—wherever shafts turn—you'll find the new National SYNTECH Oil Seal an outstanding improvement over the ordinary types. Let National engineers assist in solving your bearing protection problems. The details of your problem will be kept in strictest confidence.

NATIONAL MOTOR BEARING COMPANY, INC.

General Offices: Redwood City, California
Plants: Redwood City and Los Angeles, Calif.; Van Wert, Ohio

●

CALL IN A NATIONAL ENGINEER FOR RECOMMENDATIONS

CHICAGO
Room 2014 Field Bldg., Chicago 3
Phone: Central 8663

PHILADELPHIA
401 North Broad St., Philadelphia 8
Phone: Bell-Walnut 2-6997

DETROIT
Room 1026 Fisher Bldg., Detroit 2
Phone: Trinity 16363

NEW YORK CITY
122 East 42nd St., New York City 17
Phone: Lexington 2-8260

MILWAUKEE
1717 E. Kane Place, Milwaukee 2
Phone: Lakeside 2838

HOUSTON
1 Main St., Houston 2, Texas
Phone: Preston 9862

SPRINGFIELD
124 State St., Springfield 3, Mass.
Phone: Springfield 2-1881

KANSAS CITY
1823 Walnut, Kansas City 8, Mo.
Phone: Harrison 6637

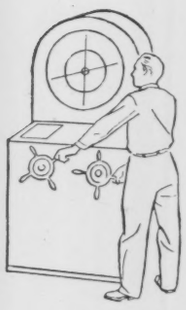
CLEVELAND
210 Heights Rockefeller Bldg., Cleveland 18
Phone: Yellowstone 2720

NATIONAL

OIL AND FLUID SEALS

WHEREVER SHAFTS MOVE, THERE'S A NATIONAL SEAL TO RETAIN THE LUBRICANT

Robin Hood would have loved these...

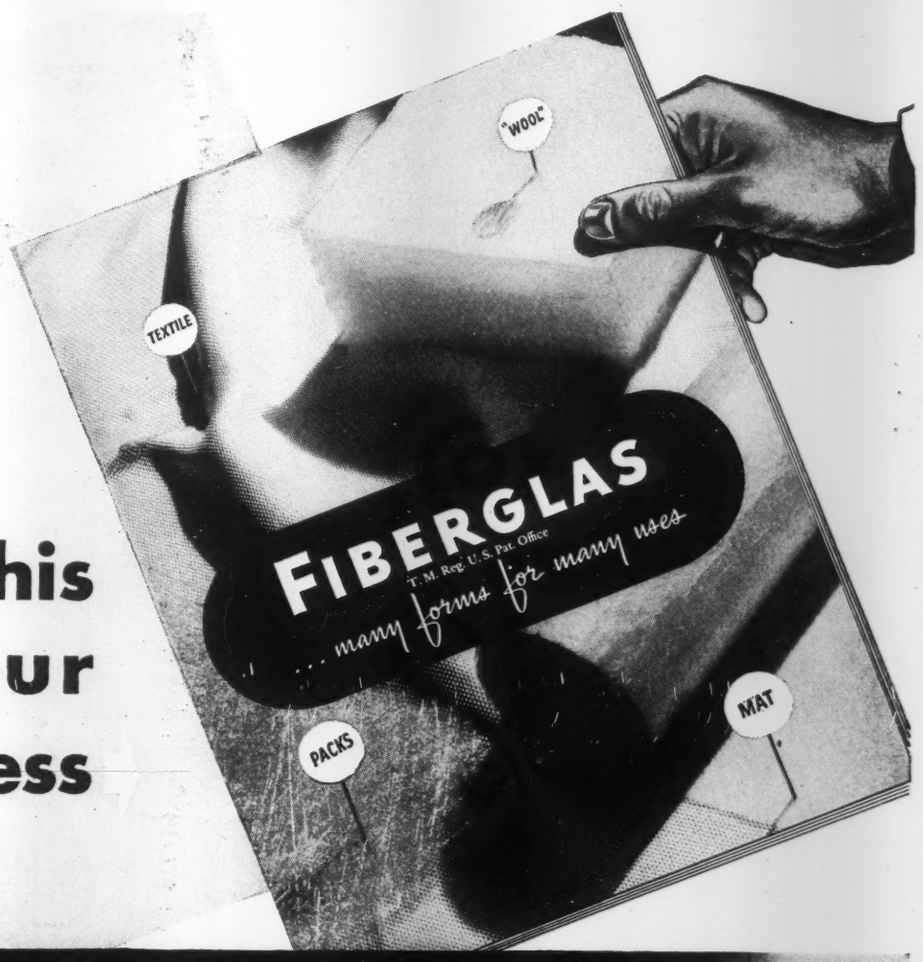


Arrows whose shafts are made from steel tubes! Matched in weight to within two grains, matched for 'spine' or stiffness to within thousandths of an inch—straight as a sunbeam—these steel-tube-shafted arrows are perfection in archery. Globe Steel tubes Co. doesn't make these arrows—but we do make steel tubes of such exceptional structural and metallurgical uniformity and quality they might readily be used for arrow shafts.

Your need in steel tubes may be wholly different from this application but whatever your requirements in carbon, alloy, stainless (seamless or *Gloweld* welded) and high purity ingot iron (*Globeiron*) tubes — look to Globe as a specialized, dependable source of supply. Globe engineers and technicians gladly cooperate to help you find exactly the tubing you need for even the most unusual application. Globe Steel Tubes Co., Milwaukee 4, Wisconsin.

Seamless Tubes—Carbon—Alloy—Stainless Steels; *Gloweld* Welded Stainless Steel Tubing; *Globeiron* High Purity Ingot Iron Seamless Tubes; Mechanical Tubing—Pressure Tubing—Tubing for Corrosion and Heat Resisting Applications.

You can use this in your business



ATTENTION PRODUCT ENGINEERS!

Fiberglas in one or more of its many forms is being used by engineers in the development of a wide range of products for industrial processes and consumer use.

A copy of the booklet, "Fiberglas—many forms for many uses", should be on the desk of everyone concerned with product design or development. It describes the various forms in which Fiberglas is produced. It outlines the commercially significant characteristics and lists typical uses of this versatile material.

Fiberglas is the trade name for many products made by Owens-Corning Fiberglas Corporation, of light, strong, moisture and heat resistant, ageless glass in pliable fiber form.

Fiberglas may be the answer to some of your problems. Mail the coupon today for your copy of the booklet "Fiberglas—many forms for many uses". Or, if you are working on products in which the specific uses listed below are concerned, check the item for complete information.

OWENS-CORNING
FIBERGLAS
T.M. REG. U.S. PAT. OFF.

Owens-Corning Fiberglas Corporation, Dept. 808
Toledo 1, Ohio

☐ Send me, without obligation, a copy of "Fiberglas—many forms for many uses".

I would like to have specific information on Fiberglas for:

☐ Thermal Insulation (High temperature)
☐ Thermal Insulation (Low temperature)
☐ Sound deadening
☐ Electrical Insulation
☐ Air Filtering
☐ Fabrics—noncombustible, acid resistant
☐ Fabrics—coated
☐ Plastics reinforcement

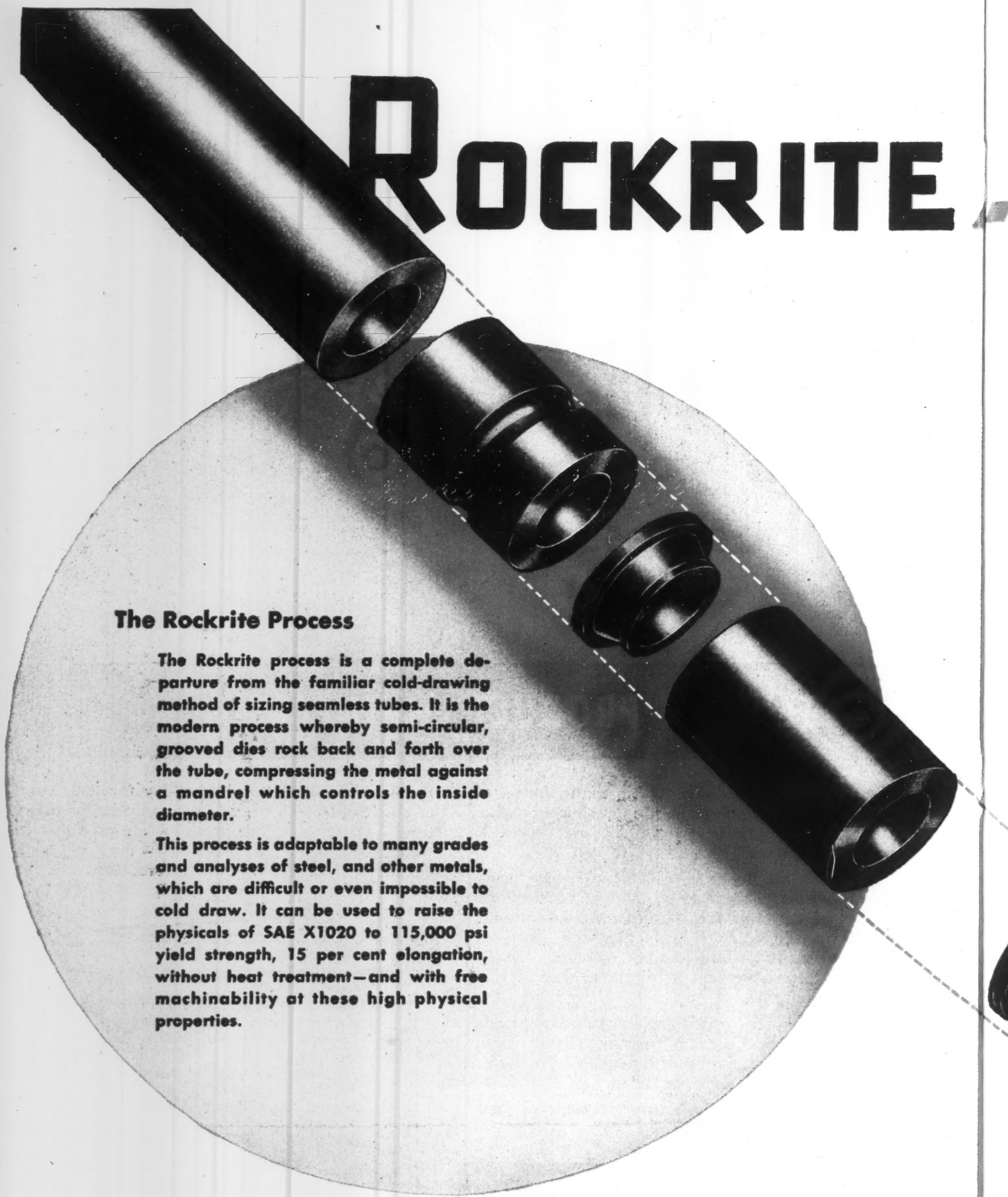
Name_____ (title)_____

Company_____

Address_____

City_____ State_____

ROCKRITE



The Rockrite Process

The Rockrite process is a complete departure from the familiar cold-drawing method of sizing seamless tubes. It is the modern process whereby semi-circular, grooved dies rock back and forth over the tube, compressing the metal against a mandrel which controls the inside diameter.

This process is adaptable to many grades and analyses of steel, and other metals, which are difficult or even impossible to cold draw. It can be used to raise the physicals of SAE X1020 to 115,000 psi yield strength, 15 per cent elongation, without heat treatment—and with free machinability at these high physical properties.

... CLOSE-TOLERANCE TUBING

will help cut the costs of these 1947 *products*

As the buyers' market makes itself felt and business gets back to the brass tacks of competitive operations, machined parts like those illustrated are being made faster—and at lower cost—from close tolerance Rockrite Tubing than from ordinary tubing or from bar stock.

The advantages of fabricating from Rockrite has been demonstrated in the high-speed production of war-plant operation. In one case the use of Rockrite Tubing resulted in a 60 per cent increase in the output of finished parts. In another, production was doubled. Corresponding reductions in cost were, of course, realized.

Such cost reductions are possible with Rockrite Tubing because it is more accurate in dimensions than tubes sized by any other commercial method. It is more concentric, has lower variations in wall thickness, and is sized to closer outside- and inside-diameter tolerances. This means lighter, faster, more uniform cuts in machining, longer tool life, practicable use of forming tools and other cost-cutting advantages.

Inquiries from designers of 1947 products are invited, and will be held in strictest confidence.

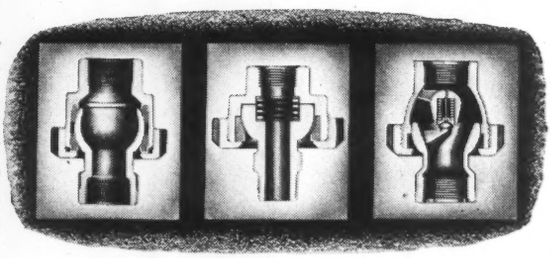
TUBE REDUCING CORPORATION

WALLINGTON, N. J.

VIBRATION GIVES THE PITCH IN A TUNING FORK

but gives trouble in fluid lines

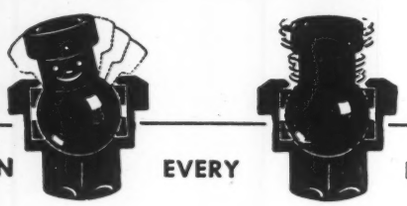
Vibration serves a useful purpose sometimes, but in a fluid-conveying system it is a destructive force. Barco Flexible Joints, for thirty years past, have provided protection for fluid lines in an ever-expanding range of industrial and transportation services. These expertly engineered joints allow responsive movement in any direction, absorbing shock and strain, compensating for expansion and contraction, insuring full fluid-carrying capacity. Write for complete engineering data on this famous line. Barco Manufacturing Co., Not Inc., 1806 Winnemac Avenue, Chicago 40, Illinois.



BARCO FLEXIBLE JOINTS

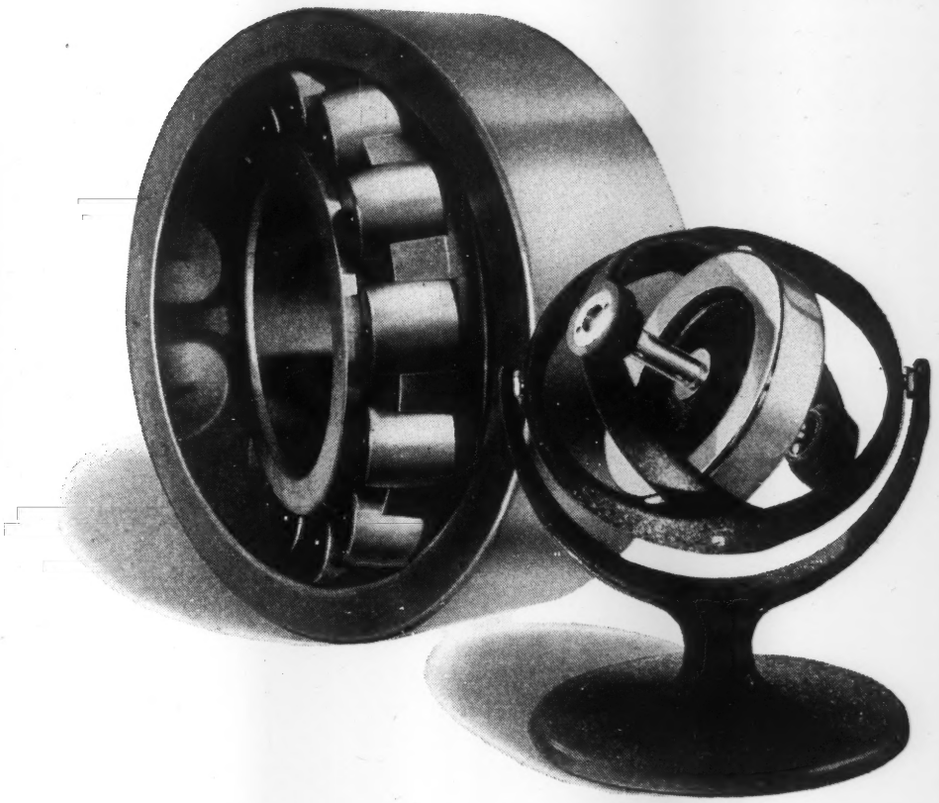
Not just a swivel joint ... but a combination of a swivel and ball joint with rotary motion and responsive movement through every angle.

FREE ENTERPRISE—THE CORNERSTONE OF AMERICAN PROSPERITY



In Canada: The Holden Co., Ltd., Montreal, Canada.

"MOVE IN EVERY DIRECTION"



Operating stability...

is characteristic of both the gyroscopic rotor and the Torrington *Spherical* Roller Bearing. Despite shaft deflection or misalignment, the self-aligning feature of the *Spherical* Roller Bearing

Assures sustained load capacity...

since the full area of bearing contact surface is maintained between rollers and spherical outer race bore. This feature of the *Spherical* Roller Bearing is responsible for its long, efficient and adjustment-free operation in many heavy-duty machines.

Check this and many other advantages of the Torrington *Spherical* Roller Bearing against the requirements of *your* installation. Write today for a copy of our Bulletin #200.

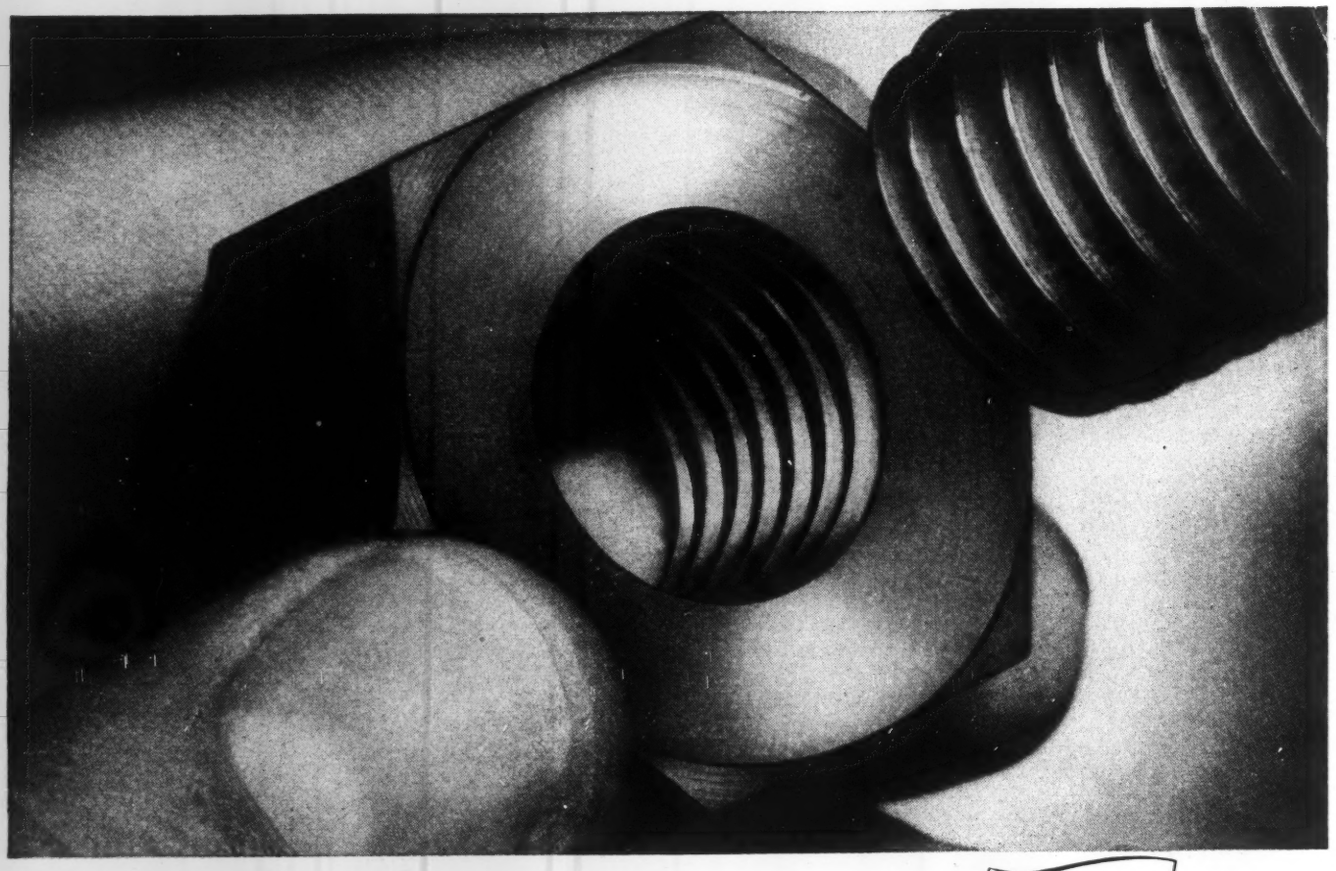
THE TORRINGTON COMPANY

SOUTH BEND 21, IND. TORRINGTON, CONN.

Offices in All Principal Cities

TORRINGTON BEARINGS

• NEEDLE • SPHERICAL ROLLER • STRAIGHT ROLLER • TAPERED ROLLER • BALL •



WHEN YOU LOWER THE COST OF USING FASTENERS . . . THAT'S t.f.e.

True Fastener Economy!

Since the time and labor costs of assembling a nut on a bolt usually exceed the cost of the fasteners, it's *T*rue *F*astener *E*conomy to buy the brand that gives maximum speed and convenience in assembly.

R B & W *Nuts Save Assembly Time*

The care which RB & W takes to produce nuts with utmost accuracy and uniformity . . . pays off in terms of lower assembly cost. Careful selection of material; cold-punching that insures toughness, freedom from splitting, uniformity of size; repunching that guarantees concentricity of hole; burnishing that assures smoothness of all surfaces; tapping on machines of special design that provide accurate, clean threads . . . result in nuts that run on quickly and take severe wrenching in their stride.

You Get T. F. E. When You

1. Reduce assembly time to a minimum by savings through use of accurate and uniform fasteners
2. Make your men happier by giving them fasteners that make their work easier
3. Reduce need for thorough plant inspection, due to confidence in supplier's quality control
4. Reduce the number and size of fasteners by proper design
5. Purchase maximum holding power per dollar of initial cost, by specifying correct type and size of fasteners
6. Simplify inventories by standardizing on fewer types and sizes of fasteners
7. Save purchasing time by buying larger quantities from one supplier's complete line
8. Contribute to sales value of final product by using fasteners with a reputation for dependability and finish

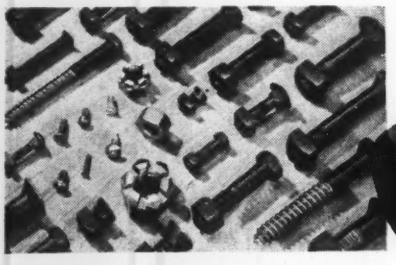
RUSSELL, BURDSALL & WARD BOLT AND NUT COMPANY

102 years making strong the things that make America strong

RB&W bolts, nuts, screws, rivets and allied fastening products are manufactured in a broad range of styles, sizes and finishes.

• • •

Plants at: Port Chester, N. Y., Coraopolis, Pa., Rock Falls, Ill., Los Angeles, Calif. Additional sales offices at: Philadelphia, Detroit, Chicago, Chattanooga, Portland, Seattle. Distributors from coast to coast. By ordering through your distributor, you can get prompt service from his stocks for your normal needs. Also—the industry's most complete, easiest-to-use catalog.



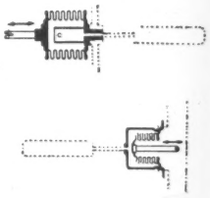
Got a pressure or temperature control *problem?*

MAYBE *your answer* IS HERE!

BRIDGEPORT metal bellows, bellows assemblies and devices. are used in all industries to help solve pressure and temperature control problems. They are designed and produced on order to fit *exactly* into your product plans. And, Bridgeport skilled engineers *make sure* that the bellows they recommend performs as promised—to your complete satisfaction. Bridgeport metal bellows available in a wide range of metals in sizes from 15/32″ to 12″ O. D. For complete information, write for Catalog CK-100.

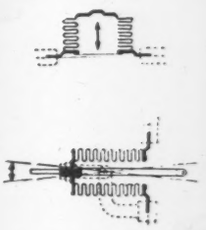
Typical applications—BRIDGEPORT METAL BELLOWS

Thermostatic Motor (Right, Above)—Widely used in temperature regulators, etc. Thermostatic charge confined in bellows. Used to operate a valve, switch, damper, etc., in response to temperature changes. Available with or without remote bulb. Without thermostatic charge and bulb, serves as Pressure Motor.



Thermostatic Motor (Left, Below)—Thermostatic charge confined outside bellows and within a cup. Same usage as figure above. Available with or without remote bulb. By omitting thermostatic charge and bulb, would serve as Pressure Motor.

Expansion Chamber (Right, Above)—Employed to absorb thermal or pressure expansion. With suitable heads, would serve as reservoir for a liquid or gas. Example: Oil reservoir for electrical cable joint.



Flexible Joint (Left, Below)—Providing a means to seal a flexible joint or mechanical movement of levers, linkage, etc., against leakage where the movement must be conveyed outside an enclosure. Example: Operating stem of float switches, etc.

Bellows Assemblies . . . Bellows . . . Bellows Devices

BRIDGEPORT THERMOSTAT

COMPANY, Incorporated • Bridgeport 1, Conn.

4-WINGED DRIVER CAN'T SLIP OUT OF PHILLIPS TAPERED RECESS

RADIO Builders and Listeners ...Both Give Top Rating

to these Cost-Controlling, Good-Looking AMERICAN PHILLIPS SCREWS

1. TOP RATING in Production Savings: Fast, fumble-proof, automatically straight-driving . . . American Phillips Screws make possible high-volume radio production where even the slightest surface-scratch means "reject." For at highest speeds, the 4-winged American Phillips Driver can't twist out to scar work-surfaces! *Speed . . . with complete safety both for work and workers . . .* that's the double advantage that makes American Phillips Screws the *lowest-cost fastening method on any job.* Whatever product *you* assemble, you will find that American Phillips Screws pay off with SAVINGS UP TO 50%.

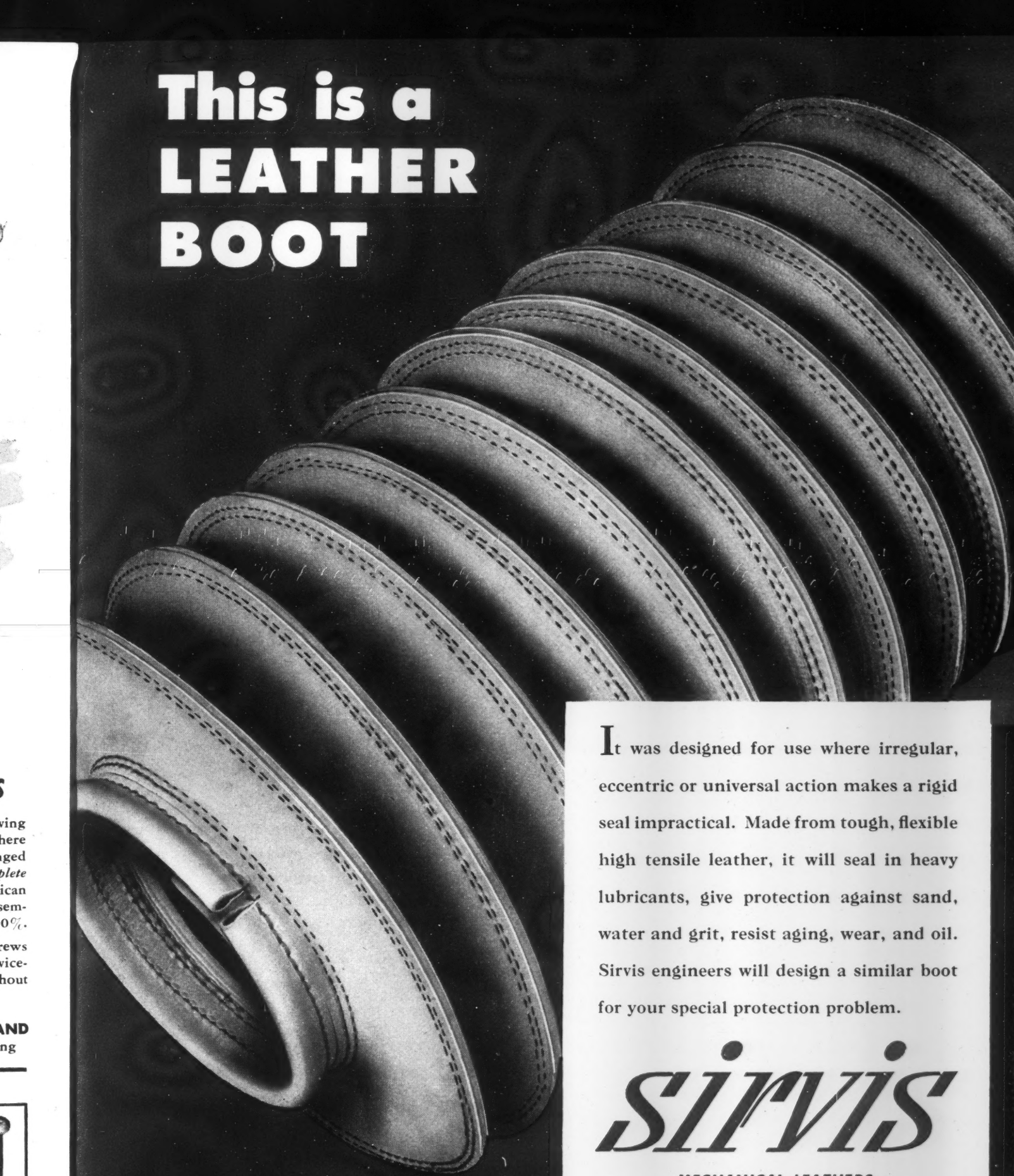
2. TOP RATING in Sales Promotion: The decorative heads of American Phillips Screws are a customer-accepted mark of quality. And they're an added assurance of serviceability under incessant use. So standardize on American Phillips Screws throughout your assembly departments. Write:

AMERICAN SCREW COMPANY, PROVIDENCE 1, RHODE ISLAND
Chicago 11: 589 E. Illinois St. *Detroit 2:* 502 Stephenson Building

AMERICAN PHILLIPS *Screws*

ALL TYPES
ALL METALS: Steel, Brass, Bronze, Stainless Steel, Aluminum, Monel, Everdur (silicon bronze)

This is a LEATHER BOOT



It was designed for use where irregular, eccentric or universal action makes a rigid seal impractical. Made from tough, flexible high tensile leather, it will seal in heavy lubricants, give protection against sand, water and grit, resist aging, wear, and oil. Sirvis engineers will design a similar boot for your special protection problem.

sirvis

MECHANICAL LEATHERS

Products of

CHICAGO RAWHIDE MANUFACTURING CO.

1304 Elston Avenue **Chicago 22, Illinois**

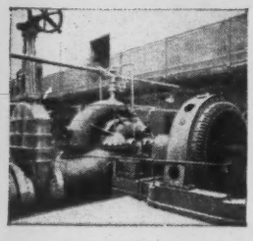
New York · Philadelphia · Detroit · Los Angeles · Cleveland · Boston
Pittsburgh · San Francisco · Cincinnati · Portland · Syracuse · Peoria

INDUSTRY BANS RUST AND CORROSION *with* EVERLASTING FASTENINGS

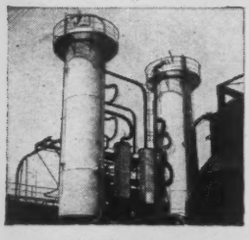
Few industries can escape the destructive effects of rust and corrosion but *all* industries can reduce their costly ravages in maintenance and breakdown.

Here are five industrial applications where Harper's EVERLASTING FASTENINGS have licked rust and corrosion.

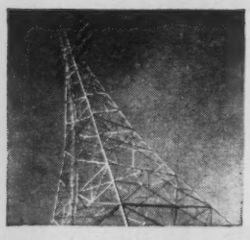
MONEL STOPS CORROSIVE CHEMICALS Problems in salt production have been solved by using Monel bolts. In mining, treating and handling of many chemicals, nonferrous alloys are the answer to efficient operation.



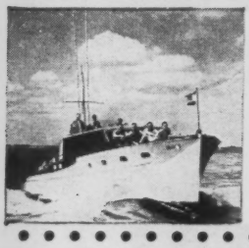
BRASS GUARDS WATER SYSTEMS In valves and pumps that compose the heart of water works, Brass fastenings help in eliminating the most common cause of replacement—rust.



STAINLESS STEEL SOLVES OIL PROBLEMS Acids and gases at high temperatures attack metal but Stainless Steel alloys cut refinery replacements to a minimum, assure years of continued operation.



UTILITIES CHOOSE SILICON BRONZE Weather is the bug-a-boo in power lines and other utility applications. Silicon Bronze Bolts reduce season "cracking" and maintenance costs.



NAVAL BRONZE WINS ON THE SEA Marine applications demand high strength plus resistance to salt air and water. Naval Bronze fastenings have proved their dependability in marine diesels and ship fittings.

THE H. M. HARPER COMPANY 2626 Fletcher Street Chicago 18, Illinois

Branch Offices:
New York City
Philadelphia
Los Angeles
Milwaukee
Cincinnati
Dallas
Representatives in Principal Cities

Call upon Harper to solve fastening problems in *your* industry

BLACKMER PUMPS

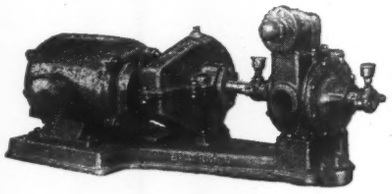
The Key to

- LOWER PUMPING COSTS
- SUSTAINED PUMPING CAPACITY
- PUMP DEPENDABILITY

Write for Bulletin No. 307

FACTS ABOUT ROTARY PUMPS

which explains why the "Bucket Design" (swinging vane principle) maintains pumping capacity by automatically compensating for wear and how the buckets, when finally worn out, are easily replaced and the pump restored to its normal capacity.



OUR ENGINEERS ARE AT YOUR SERVICE

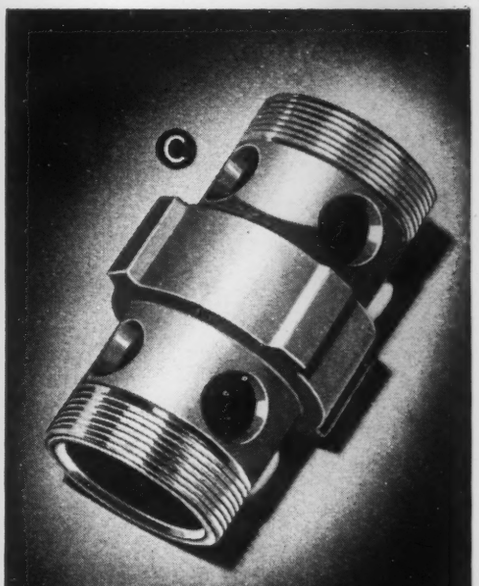
BLACKMER PUMP COMPANY
1970 Century Avenue Grand Rapids 9, Michigan

POWER PUMPS - HAND PUMPS · EZY-KLEEN STRAINERS ·

Scovill

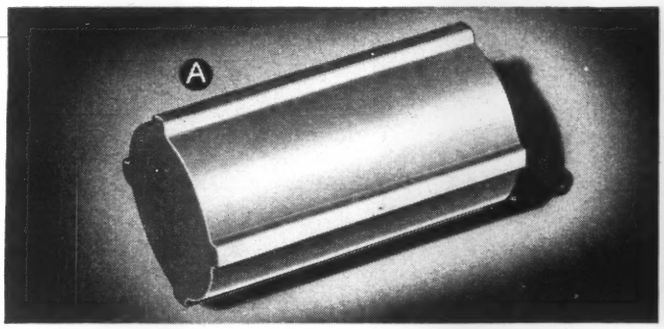
NON-FERROUS

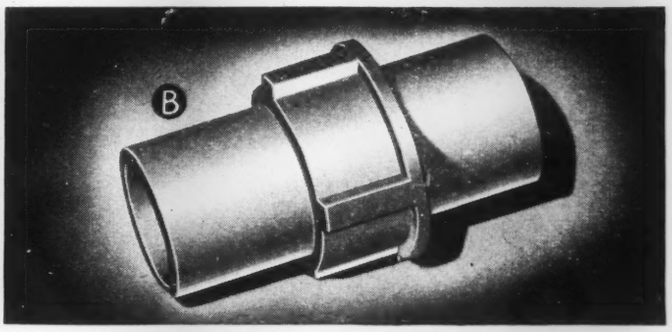
FORGINGS



What's the most economical way to make this aluminum part for a valve body?

When SCOVILL becomes your METAL-PARTner . . . questions like this are easy to answer:





Originally made from this special shaped rod — 460 pounds per 1,000 pieces — the part required extensive and expensive machining operations. Compare Parts A and C.

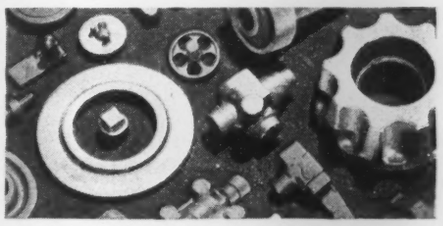
When the part was made as a Scovill Forging, only 220 lbs. of aluminum were needed per 1,000 pieces, and as you can see by comparing Parts B and A, plenty of machining time was eliminated.

RESULT: Scovill Forgings give the customer considerable savings.

SCOVILL *Masters of Metal*

LOOK TO SCOVILL!

You, as do many of our satisfied customers, may find that your brass, aluminum or other non-ferrous parts can benefit greatly from a change in design or manufacturing method. Out of our backlog of non-ferrous forging experience and ability may come the *extra* that will give you the edge on competition. Let's explore how you may profit from making Scovill *your* METAL-PART*ner*. To start things moving, fill in the coupon and mail it today. Scovill Manufacturing Company, Waterbury 91, Conn. *Export Department:* 405 Lexington Avenue, New York 17, N. Y.



Please send me information about your metal-working facilities. I am interested in non-ferrous forgings for the applications checked:

- ☐ Aircraft
- ☐ Automobiles
- ☐ Band Instruments
- ☐ Blow Torches
- ☐ Cameras
- ☐ Communication Equipment
- ☐ Cylinder Valves
- ☐ Fire Extinguishers
- ☐ Household Appliances
- ☐ Industrial Instruments
- ☐ Plumbing Goods
- ☐ Pumps
- ☐ Valves
- ☐ Welding Equipment

Other applications .....

.....

SCOVILL MANUFACTURING COMPANY

Forgings Division

19 Mill Street

Waterbury 91, Connecticut

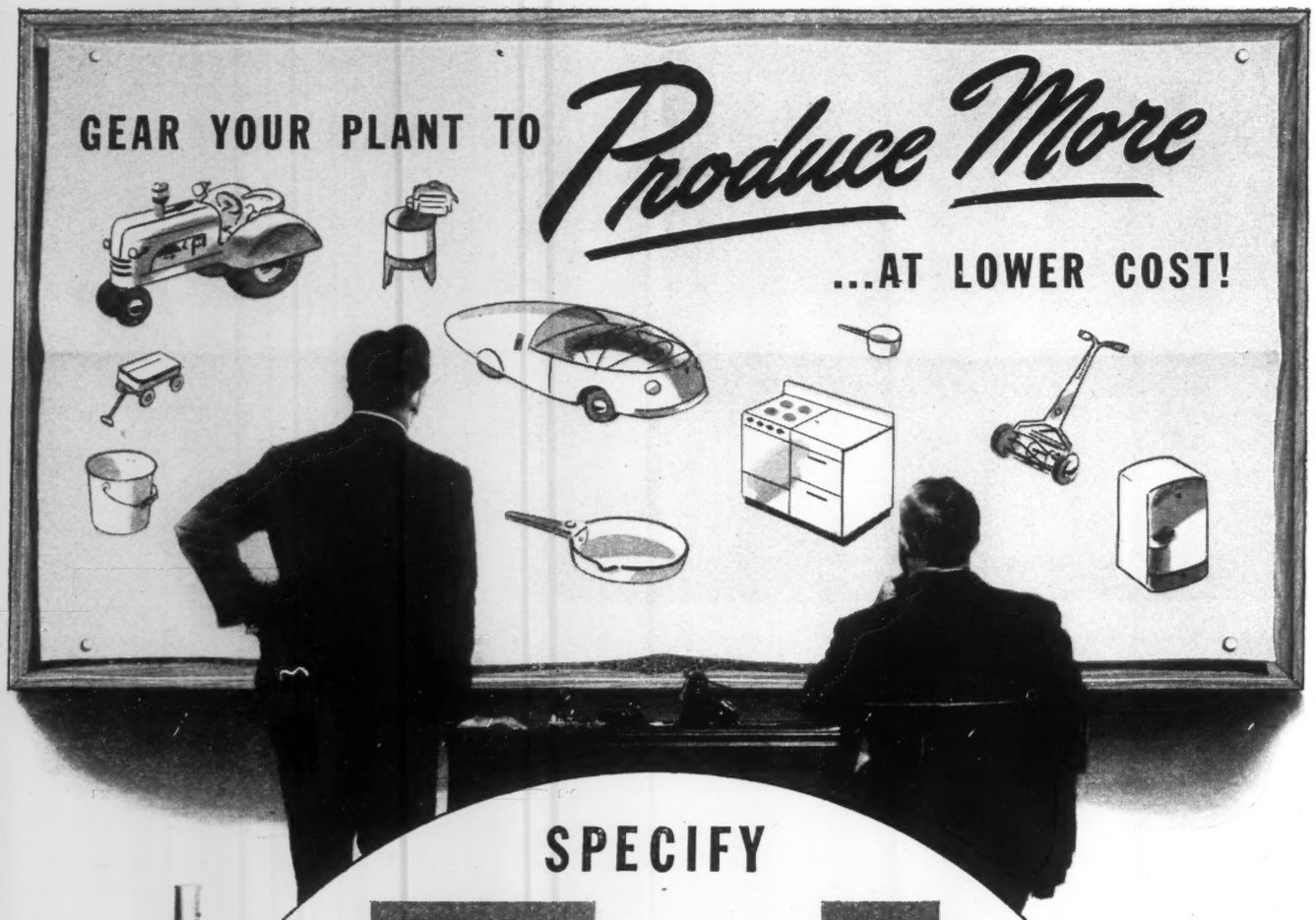
Name .....

Company .....

Address .....

GEAR YOUR PLANT TO *Produce More*

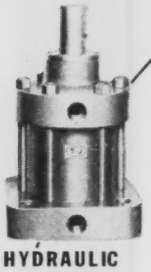
...AT LOWER COST!



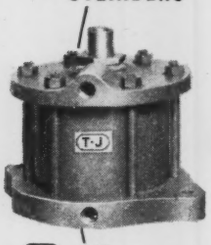
SPECIFY

T-J

for Tough Jobs!



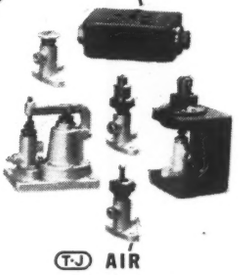
T-J HYDRAULIC CYLINDERS



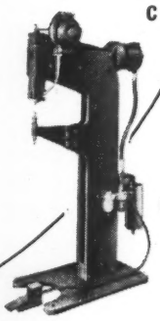
T-J AIR CYLINDERS

T-J CLINCHORS

T-J CUTTERS



T-J AIR CONTROLS



T-J RIVITORS

T-J Performance is helping plants throughout industry handle tough jobs at *top-speed* and *efficiency* . . . with *lower costs!*

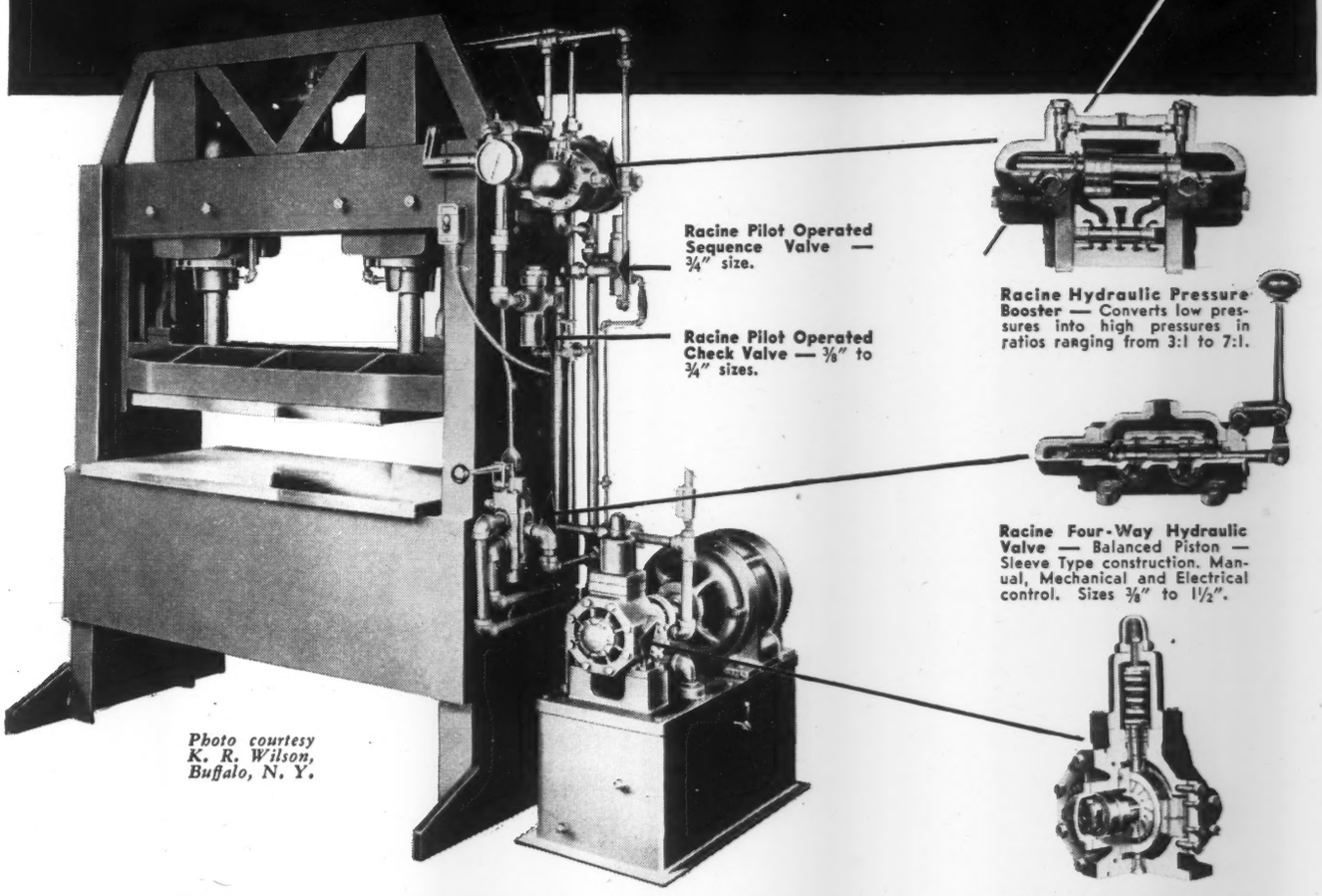
Right now in your plant—there may be many jobs that T-J Products can perform faster and better. Check your needs for air cylinders . . . hydraulic cylinders . . . Rivitors . . . cutters . . . Clinchors . . . or air controls—these are products that T-J builds with ahead-of-the-times features! Backed by more than a quarter of a century's experience . . . T-J engineered and precision-built for utmost *accuracy* and *dependability.* Write for bulletins. The Tomkins-Johnson Co., Jackson, Mich.

TOMKINS-JOHNSON

RIVITORS...AIR AND HYDRAULIC CYLINDERS...CUTTERS...CLINCHORS

T-J

RACINE HYDRAULICS



Racine Pilot Operated Sequence Valve — ¾" size.

Racine Pilot Operated Check Valve — ⅜" to ¾" sizes.

Racine Hydraulic Pressure Booster — Converts low pressures into high pressures in ratios ranging from 3:1 to 7:1.

Racine Four-Way Hydraulic Valve — Balanced Piston — Sleeve Type construction. Manual, Mechanical and Electrical control. Sizes ⅜" to 1½".

Racine Variable Volume Oil Hydraulic Pump — 12 to 30 G.P.M. Pressure 50 to 1000 lbs. p.s.i.

Photo courtesy K. R. Wilson, Buffalo, N. Y.

INTEGRATED TO YOUR DESIGN . . . CENTRALIZED OR REMOTE CONTROL

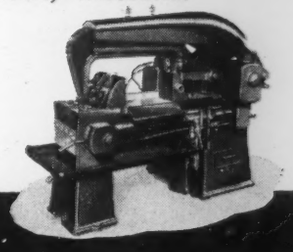
Like this press manufacturer, you can readily give your products the advantage of a RACINE "Variable Volume", hydraulic circuit. This feature saves horsepower and reduces heat by simplifying the installation and eliminating unnecessary relief and bypass valves. Important savings in first cost also result.

RACINE Hydraulic Engineers have developed hydraulic operation and control for hundreds of machines and tools. Their experience can be helpful in applying "RACINE Hydraulics" to your present product and on new designs now in the development stage. They will cheerfully review your problems in power movement, without cost or obligation.

Let us submit detailed recommendations and circuits employing pressures as high as 3000 lbs. p.s.i. Utilize the Variable Volume feature of RACINE Pumps and easy operating, long-lived RACINE sleeve-type valves. Ask for RACINE catalog P-10-C today. RACINE TOOL AND MACHINE COMPANY, 1773 State St., Racine, Wisconsin.

RACINE *Hydraulic* METAL CUTTING MACHINES

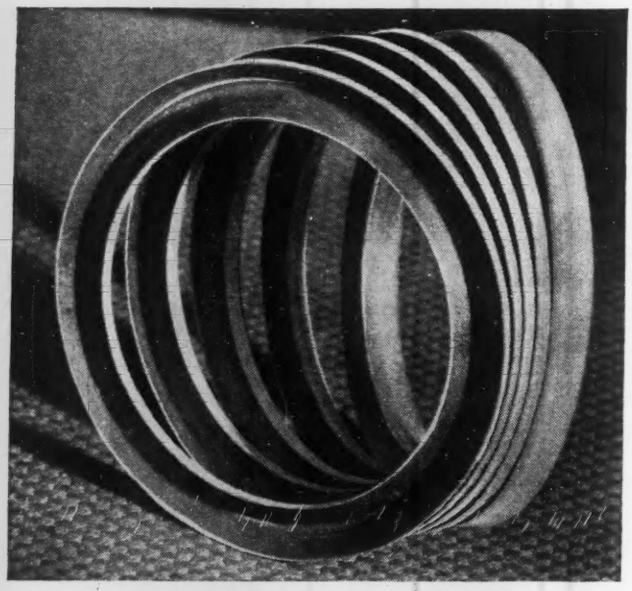
A complete line in capacities 6" x 6" to 20" x 20". Models in all price ranges — featuring simple one lever control — open front design — progressive feed for cutting any metal from light tubings to structural shapes and billets of tough tool steels. Write for complete catalog No. 12.



STANDARD FOR QUALITY AND PRECISION — RACINE TOOL and MACHINE CO.

RACINE STANDARD FOR QUALITY AND PRECISION

The subject of Page 6 in our new Leather Packing Guide is



VEE Packings

The illustration alongside, taken from page 6 of the new Leather Packing Guide, shows a series of VEE Packings with a female adapter.

On page 6 and part of page 7 there is a complete description of the VEE Packing assembly which makes a most effective seal because of the multiple sealing lips. VEE's can be conveniently used on inside or outside packed gland assemblies, and for reciprocating or rotating motion, or a combination of both. There is also a mechanical drawing of a nested leather VEE assembly design showing a cross-sectional view. Throughout the booklet all other leather packings are also illustrated and described—with tables, descriptions, instructions, formulas, etc. that every user of hydraulic and pneumatic machinery should have.

SEND FOR YOUR COPY OF THE LEATHER PACKING GUIDE . . . *Interesting, Informative*

ALEXANDER PHILADELPHIA

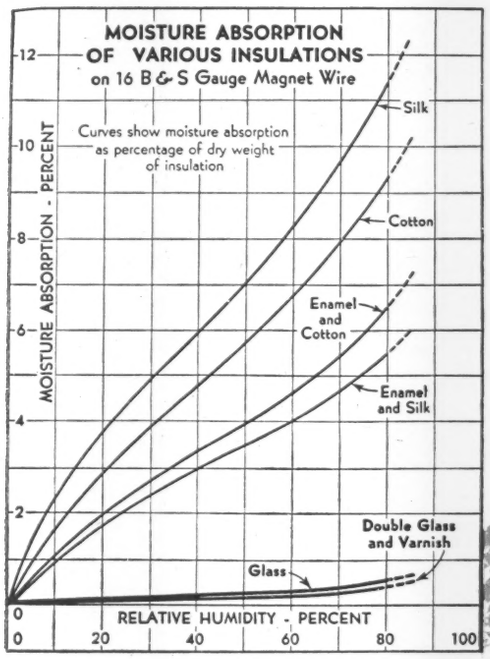
FOUNDED 1867

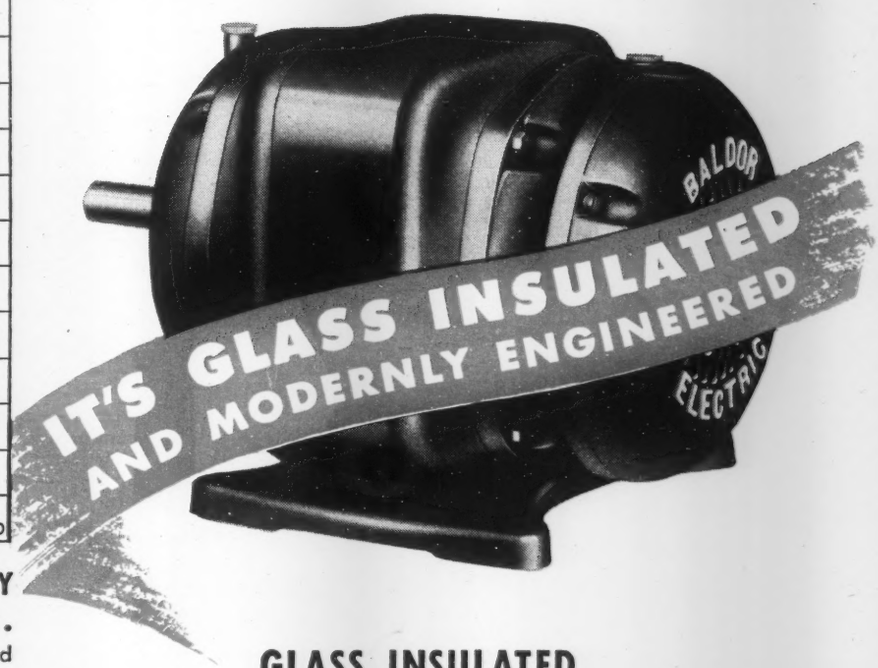
ALEXANDER BROTHERS

406 N. THIRD STREET PHILADELPHIA 23, PA.

BRANCH OFFICES: CHICAGO • DALLAS • CHARLOTTE • NEW YORK

Distributors in all Principal Cities





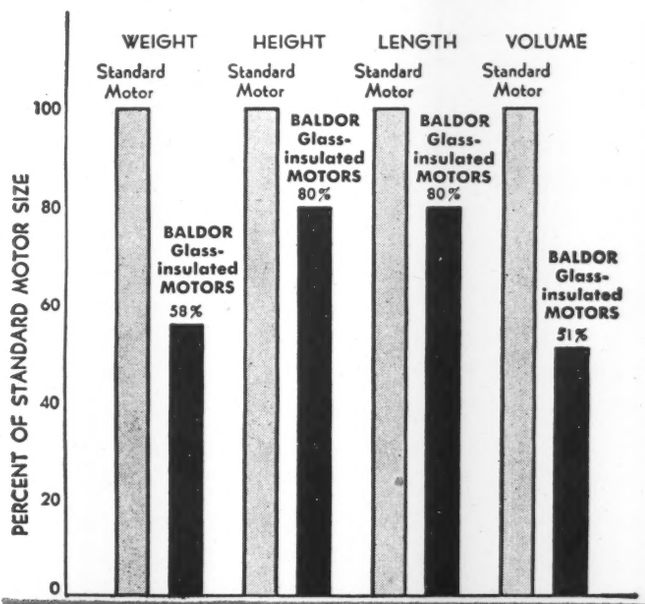
LONG, SATISFACTORY SERVICE is assured...

because glass-insulated motors withstand high ambient temperatures, are not affected by excessive moisture nor by peak loads.

These motors are more compact . . . not burdened by excessive size nor weight. They provide MORE HORSE POWER per pound of active materials, with no sacrifice of quality, efficiency nor performance.

BALDOR GLASS-INSULATED MOTORS

Compared to Size of Standard Class A Insulated Motors
10 H.P. 1800 R.P.M. - Totally Enclosed Fan Cooled



GLASS INSULATED STREAMCOOLED MOTORS

Engineered by Baldor have these important features:

1. Totally enclosed, externally ventilated.
2. Drip-proof; splash-proof; grit-proof; lint-proof.
3. Horizontal, vertical and side-wall mounting.
4. Removable base.
5. End plates interchangeable for face mounting.

Glass-insulated motors are as modern as plastics and atomic energy, and their adoption is consistent with your modernly designed, year-ahead engineered products and equipment.

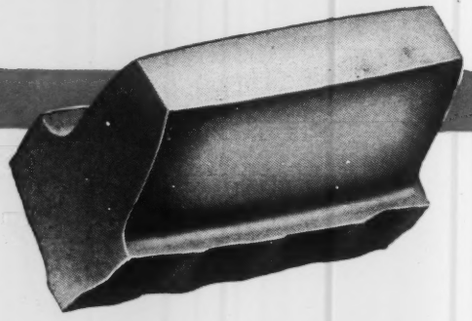
Baldor

BETTER MOTORS

ST. LOUIS
4353 DUNCAN AVE.
AND PRINCIPAL CITIES

BALDOR...*motor specialists and pioneers for more than 25 years*

ELLIPTOID TEETH for the Modern HEAVY DUTY GEAR



The Elliptoid tooth form has a very important function. It confines operating load concentrations to the strong central region of the tooth and prevents such concentrations at the ends of the tooth where it is weakest and therefore most vulnerable to failure.

The actual difference in tooth thickness between the ends and center of an Elliptoid tooth need be very little (.0003" to .0005" per inch of face) but when that difference is consistently maintained the tooth always develops its maximum operating strength.

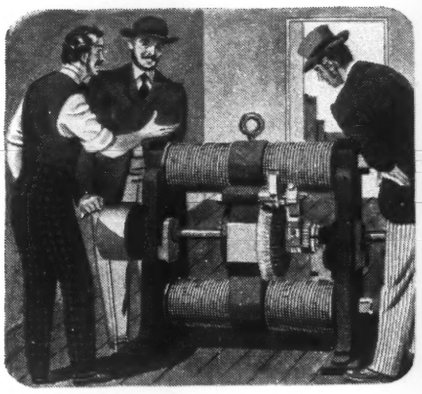
The Elliptoid tooth form is developed on Red Ring Rotary Shaving Machines which, in addition, correct errors in tooth spacing, helical angle, profile, eccentricity and surface finish.

NATIONAL BROACH AND MACHINE CO.

5600 ST. JEAN — RED RING ○ PRODUCTS — DETROIT 13, MICH.

SPECIALISTS ON SPUR AND HELICAL INVOLUTE GEAR PRACTICE

ORIGINATORS OF ROTARY SHAVING AND ELLIPTOID TOOTH FORMS

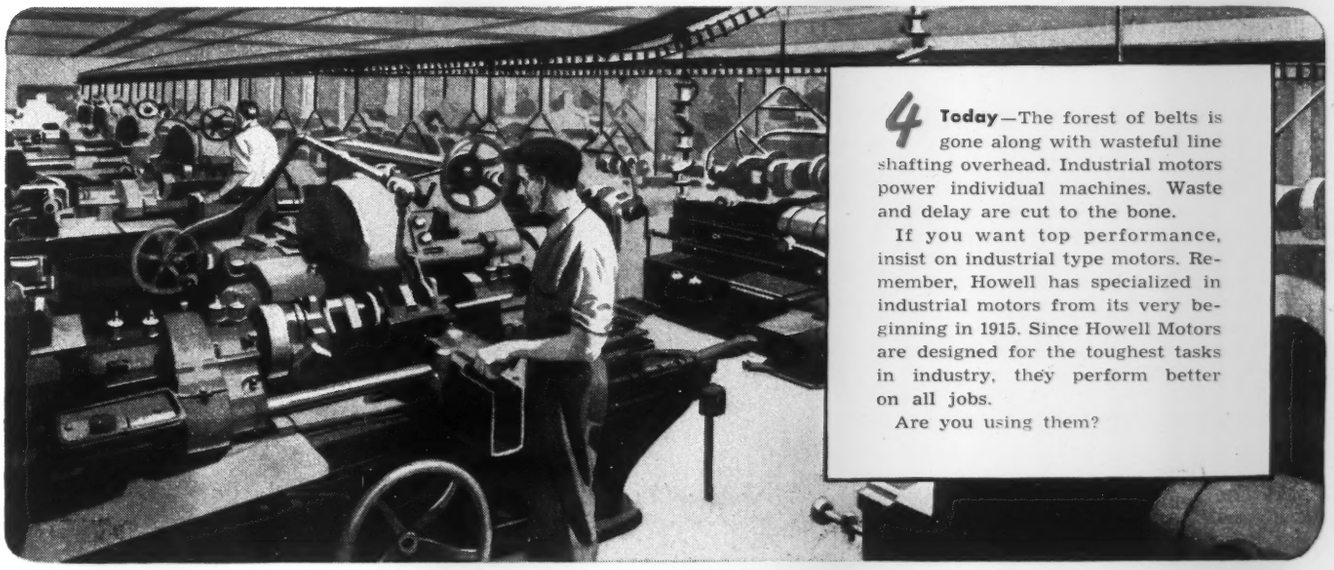


1 1870—The first electric motor was discovered by accident. Its invention revolutionized the lives of millions. Graphically, here's how its development changed you from a walker to a rider.

2 1897—The first automobiles were built by "hand." They were a luxury for the few. Mass production methods with batteries of electrically driven machines to cut manufacturing costs were still to come.

3 1925—Mass production had arrived. Machines driven by electric motors were more extensively used. Prices of cars came down. Walkers became riders. But shops looked like a forest of belts.

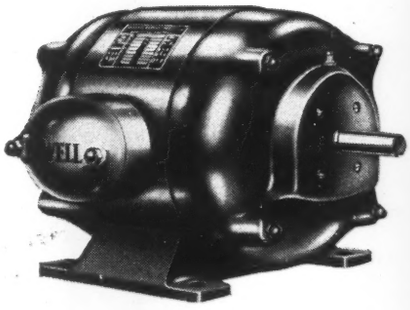
"Presto! and out went the forest of belts"



4 Today—The forest of belts is gone along with wasteful line shafting overhead. Industrial motors power individual machines. Waste and delay are cut to the bone.

If you want top performance, insist on industrial type motors. Remember, Howell has specialized in industrial motors from its very beginning in 1915. Since Howell Motors are designed for the toughest tasks in industry, they perform better on all jobs.

Are you using them?



Howell Protected Type Motors available in sizes 5 h.p. and smaller. Also other Howell industrial type motors available up to 150 h.p.

HOWELL MOTORS

HOWELL ELECTRIC MOTORS CO., HOWELL, MICH.

Manufacturers of Quality Industrial Type Motors Since 1915

He borrowed to create a business

Benjamin Franklin believed in hard work. He started his printing business on a shoestring, with borrowed money. His credit and reputation were good because he was thrifty and industrious. He delivered his printing to customers in a wheelbarrow; worked far into the night frequently. From literally nothing he developed a respected business.

American business and industry have been built only by hard work and good management. The contributions that management has made to the nation are clear: it has created great industries, millions of jobs; it has safeguarded the foundations of our business structure by planning and conducting business soundly. We shall continue to progress only if an honest day's work continues to be recognized as both desirable and necessary.

• • •

Today, the printing industry is mechanized. In thousands of printing machines, SKF bearings — both ball and roller — have conquered friction, and helped make modern printing machinery possible. Science-minded Franklin would have appreciated SKF bearings . . . they're built to do specific jobs and do them right. In printing, as in other industries, they have proved to be:

THE RIGHT BEARING FOR THE RIGHT PLACE

SKF
BALL AND ROLLER
BEARINGS

7010A

SKF INDUSTRIES, INC., PHILA., PA.

HOW TO MAKE "Veeder-Readings" COUNT IN QUALITY-CONTROL OF MANUFACTURING

Here's a Quick "Brief" of How It's Done in One Great Precision Plant:

At the start of a machine-run, pick one finished piece and check it backwards and forwards. Then decide how often the machine should be "patrolled" by the inspector (depending on tolerances, rate of tool wear, and other factors).

Now attach this OK'd part to the Operation Inspection Tag on the machine. This tag has a column of 6 blank lines, headed "*Veeder-Readings.*" And in this column, on each patrol, the inspector writes the date, time, and number of pieces completed up to that time . . . *reading directly from the Veeder-Root Counter installed on the machine.* If the last pieces don't match the first sample, he knows exactly how many pieces must be inspected 100%. Then as the run goes on, if dimensions start "walking out" again, he knows how many pieces to inspect since the last OK'd inspection. And at all times he has an accurate running record of pieces produced. Time and material are saved . . . output kept up.

This is just one instance of Veeder-Root *Count*rol. Find out how you, *in your own way,* can count to your greater profit. Write.

The Counting House of Industry

VEEDER-ROOT INC.

Hartford 2, Connecticut

In Canada: Veeder-Root of Canada, Ltd., Montreal. *In England:* Veeder-Root Ltd., Dickinson Works, 20 Purley Way, Croydon, Surrey.

Style No. 686

For Resistance to Hot Oil . . . Specify

K-68 . . . AN OUTSTANDING SHEET PACKING

K-68, R/M's Style No. 686, is a unique sheet packing which gives outstanding results where unusual resilience must be combined with resistance to oil and to extremely high temperature. K-68 sheets are made of specially selected asbestos fibres, bonded with Neoprene under great pressure.

K-68 sheets are available in widths up to 120″ and in thicknesses from 1/64″ to 1/8″.

K-68 was developed for high-output aviation engines and is recommended and being widely used for Diesel engines and for applications in oil refineries and chemical plants where gaskets must stand up against solvent and aromatic conditions at extreme heat.

K-68 contains no sulphur and is approved for use in refrigeration systems.

This outstanding packing from America's largest compressed sheet manufacturer is typical of R/M packings. R/M makes a complete line of high quality packings for every industrial use. Specify R/M, or call us for engineering service.

ASBESTOS TEXTILE & PACKING DIVISION

RAYBESTOS-MANHATTAN, INC.
MANHEIM, PA.

R/M

RAYBESTOS R M MANHATTAN

It's "Packed with Satisfaction" when you use R/M

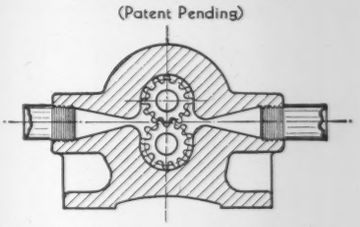
NEW Series "K" ROPER ROTARY PUMPS

HUB, FLANGE, OR FOOT MOUNTED FOR BELT, CHAIN, OR DIRECT DRIVE

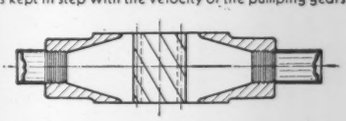
Embodying the new Roper venturi suction and discharge principle, the new Series "K" pumps are rugged, compact units that save space and reduce power costs. Liquid to the pumping gears is properly accelerated, then decelerated, improving operating efficiency and the ability of the gears to handle a wide range of viscous liquids at standard motor speeds without changing pump size to avoid cavitation and noise. Roper pumps have a high suction lift . . . are unusually quiet and operate efficiently in either direction.

They are precision built, self-lubricated by the liquid pumped, and adaptable to a wide range of jobs . . . pressure lubrication, hydraulic service, fuel supply or transfer work pumping clean liquids. Equipped with mechanical seal or packed box, with or without relief valve. May be direct connected, belt or chain driven. Interchangeable mounting brackets and adapters . . . provisions for either hub, flange, or foot mountings.

NEW VENTURI SUCTION AND DISCHARGE PRINCIPLE
(Patent Pending)



WHAT IT IS: An entirely new design application giving results unachieved with conventional pump designs. From the outside of the case the two ports are elongated, tapered openings extending to and across the full center area of the gear bores. It is a proportional means by which liquid velocity is kept in step with the velocity of the pumping gears.



WHAT IT DOES: Causes the liquid to pass through the pump with a minimum of energy loss from turbulence, friction, and cavitation. Provides a uniform distribution of liquid across the gear face increasing efficiency by reducing recirculation losses. Adds quietness and reduces power cost. Provides the means for handling a wider range of viscous liquids at standard motor speeds.

ROPER Rotary Pumps

Get all of the Facts

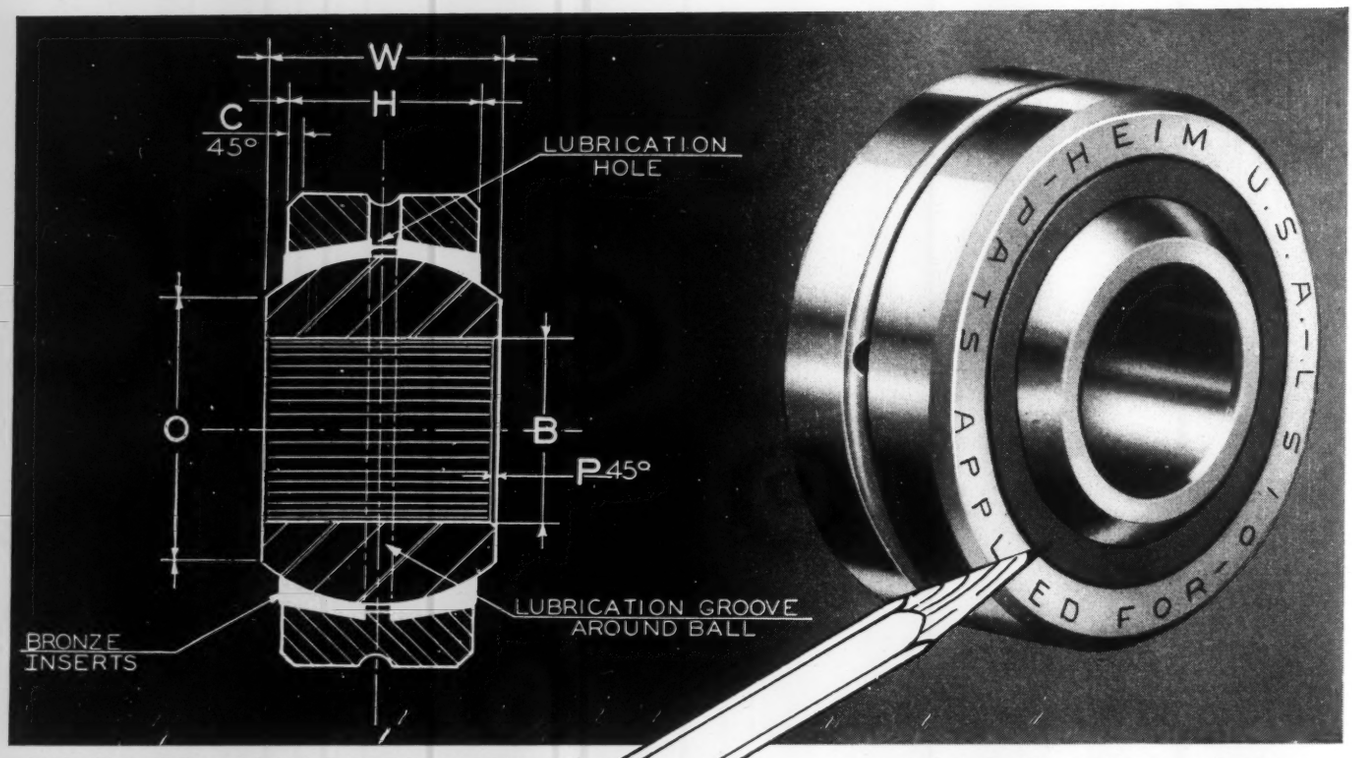
Send For Free Folder

Complete details, including: specifications, exploded view of construction features, and wide range of mounting conditions, will convince you that Roper Series "K" Pumps insure a fast, dependable solution to pump application problems.

SEE OUR CATALOG IN SWEET'S

Other Models up to 300 G.P.M., Pressures up to 1000 P.S.I.

GEO. D. ROPER CORPORATION, 242 BLACKHAWK PARK AVE., ROCKFORD, ILL.



BRONZE INSERTS HERE MAKE THIS HEIM UNIBAL BEARING RUN TRUE

HEIM

UNIBAL BEARINGS AND ROD ENDS

One ball instead of a double row of ball bearings has a greater surface supporting area, therefore a greater carrying capacity. For maximum strength and long wear, this HEIM precision bearing has a ball made from SAE 52100 steel, *hardened and ground* which rotates in inserts made of *bearing bronze*. The bronze bearing inserts are made in two parts expanded within the housing, so that ample lubrication is provided for in the groove between the two parts.

Check your present methods of transmitting motion at odd varying angles. The HEIM Unibal Bearing or Unibal Bearing Rod End corrects misalignment in any direction, and will do *your* job safer, cheaper, and better. Write our Engineering Department for suggestions in applying the Unibal Bearing to your particular product.

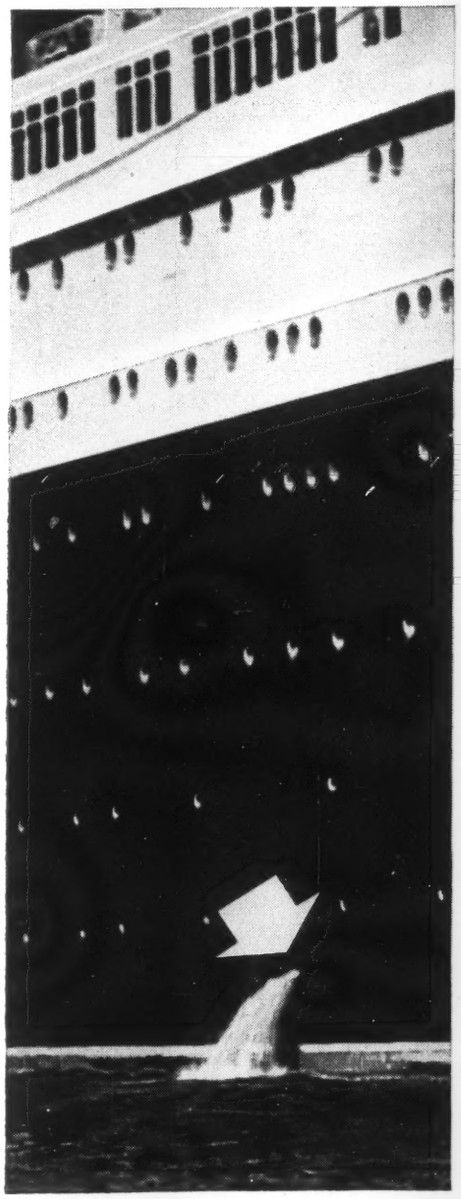
PLEASE WRITE FOR COMPLETE CATALOG

HEIM

THE HEIM COMPANY

FAIRFIELD CONNECTICUT

Heart of new marine check-valve is neoprene-covered ball...



Ball drops out of way when flow is down and out, rises and seats to prevent back-flow when sea water surges in. Neoprene-covered cork ball seals perfectly, resists cutting and abrasion.

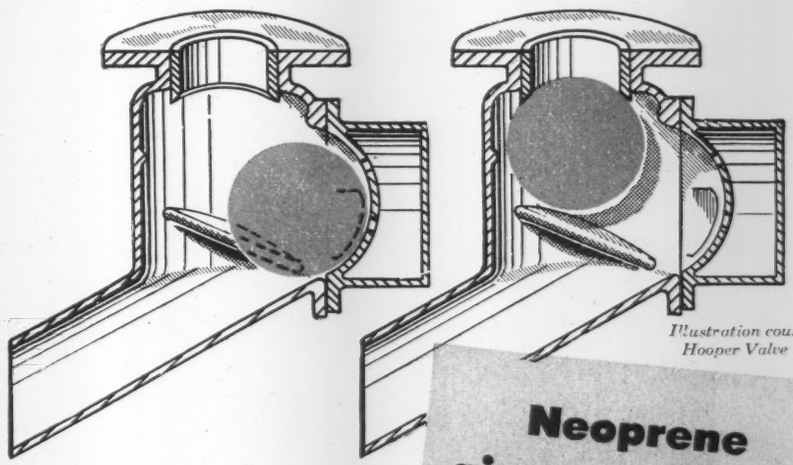


Illustration courtesy Hooper Valve Co.

Neoprene gives toughness and long life

LONG-STANDING PROBLEM of marine design had been the failure of outboard discharge valves, in which clogged and corroded flapper hinges permitted flooding and costly damage. Then an engineer developed an entirely different design, in which a buoyant ball checked the backflow.

As the sealing surface of this float, neoprene was selected. The tough neoprene coating sealed perfectly; and it held up under the toughest service conditions, resisting oil, cutting, abrasion. In tests, the neoprene-covered cork ball met every requirement and outlasted all other materials tried.

Remember neoprene when you're designing a new product. Consult Du Pont for complete technical data. Although Du Pont does not make finished neoprene products, we'll contact your supplier or help you find an adequate source.

Write today for your free subscription to *The Neoprene Notebook*. Full of stories about others who use neoprene to solve their design problems, it will give you valuable ideas. E. I. du Pont de Nemours & Co. (Inc.), Rubber Chemicals Division, A-2 Wilmington 98, Delaware.

Design for success with

NEOPRENE

The versatile synthetic rubber

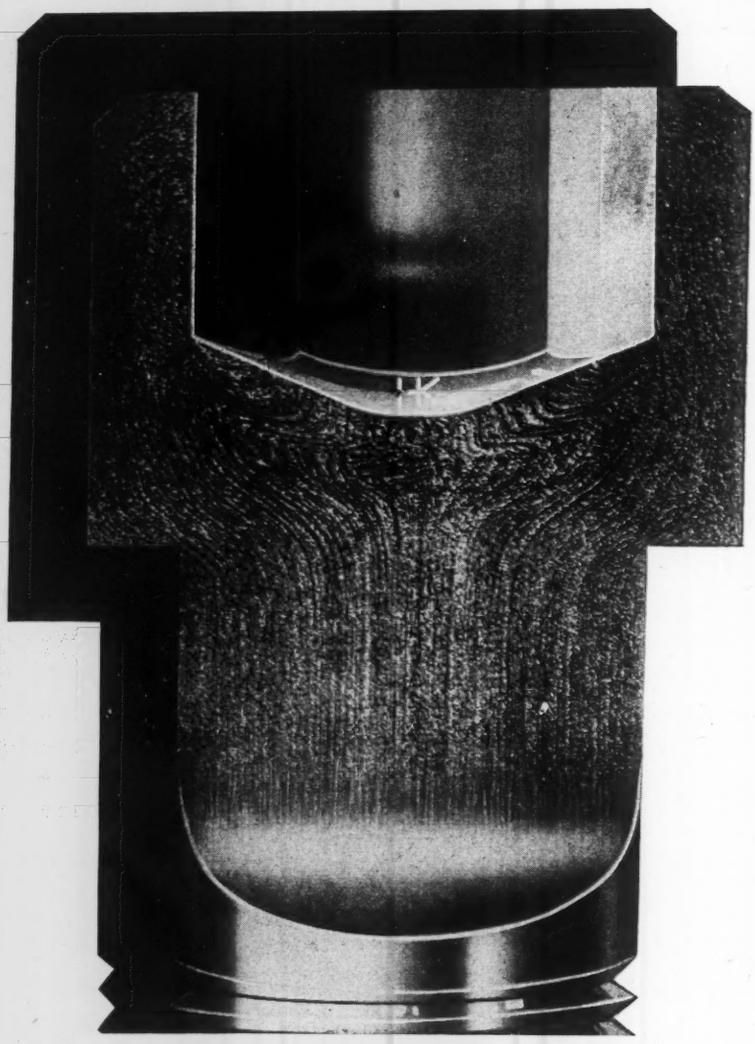
THIS DU PONT SYNTHETIC RUBBER DOES MANY JOBS SO WELL

- Gives high tensile strength and resilience; low permanent distortion.
- It's tough and durable; resists abrasion, cutting, and chipping.
- Gives best resistance to sunlight, aging, ozone, and heat.
- Resists deterioration from oils, solvents, chemicals, acids.
- Gives peak air-retention; low permeability to gases and fluids.
- Special compositions can be made flame-retarding, static-conducting, or flexible at low temperatures.

DU PONT

REG. U.S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*



Unretouched photo—etched cutaway—Holo-Krome FIBRO FORGED Socket Head Cap Screw.

NOTICE THOSE CONTINUOUS FIBRES . . .

the results of COMPLETELY COLD FORGING

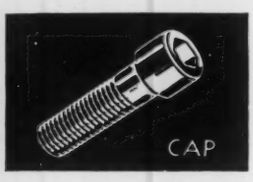
Patented Method Owned Controlled Exclusively used by Holo-Krome

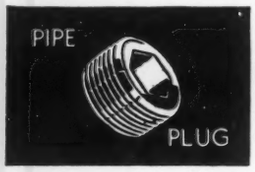
HOLO-KROME *fibro forged* SOCKET SCREWS

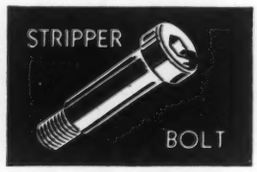
Continuous Fibres running from end to end! Uninterrupted, unbroken, unsevered! A stronger Socket Screw. This continuous fibrous structure is obtained by Completely Cold Forging — a Holo-Krome patented method.

Yes, when you specify "Holo-Krome FIBRO FORGED Screws", greater strength, uniform quality and accuracy are assured plus the saving of weight, space and assembly time in your production.

THE HOLO-KROME SCREW CORP. HARTFORD 10, CONN., U. S. A

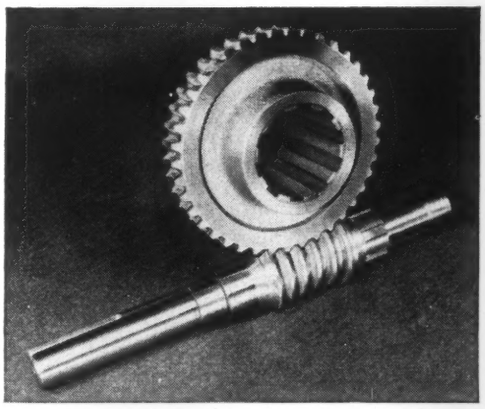






LET STANDARD CONE-DRIVE GEAR SETS CARRY THE LOAD

they'll carry more- and in less space.



Just check the ratings of some of the Cone-Drive standard matched gear sets shown in this table against the capacity of other gears. That's right. Cone-Drives will handle several times the load of other gears of the same size. What's more you can get quick delivery—standard gear sets are carried in stock in blank form. They require only final gear cutting.

For complete information on standardized Cone-Drive gear sets write today for Bulletin #700.

CONE-DRIVE DIVISION
MICHIGAN TOOL COMPANY
7171 E. McNichols Road, Detroit 12, U.S.A.

HORSEPOWER RATINGS AT 100 & 1750 PINION RPM

2 inch Center Distance		3 inch Center Distance		4 inch Center Distance		5 inch Center Distance		6 inch Center Distance		RATIO	8 inch Center Distance		10 inch Center Distance		12 inch Center Distance		15 inch Center Distance		18 inch Center Distance	
100	1750	100	1750	100	1750	100	1750	100	1750		100	1750	100	1750	100	1750	100	1750	100	1750
.35	2.96	1.24	9.04	3.00	19.8	6.07	37.0	10.4	59.1	5:1	24.4	119.2	45.8	208.	77.6	336.				
.21	1.95	.75	6.11	1.81	13.4	3.65	24.47	6.35	40.4	10:1	14.7	82.6	28.0	145.	47.1	217.	86.0	410.	133.	632.
.15	1.40	.53	4.39	1.27	9.64	2.58	18.09	4.46	29.1	15:1	10.4	61.2	19.8	105.	33.8	163.	60.5	299.	91.	446.
.11	1.10	.40	3.40	.98	7.5	2.00	13.96	3.39	22.5	20:1	7.92	46.9	15.2	81.6	26.6	131.	45.3	232.	69.	361.
.09	.86	.33	2.77	.79	6.03	1.60	11.2	2.77	18.4	25:1	6.47	38.4	12.3	66.9	21.4	106.	36.6	189.	55.5	296.
.08	.73	.27	2.32	.65	5.06	1.34	9.47	2.32	15.8	30:1	5.42	32.2	10.2	56.0	17.9	89.0	30.0	161.	46.2	248.
.06	.55	.21	1.75	.50	3.79	1.01	7.13	1.75	11.8	40:1	4.1	24.4	7.77	42.4	13.6	67.2	22.2	122.	34.2	186.
		.17	1.40	.39	3.07	.809	5.70	1.40	9.45	50:1	3.28	19.5	6.22	33.9	10.9	53.8	18.0	95.8	27.6	150.
				.33	2.54	.675	4.75	1.17	7.87	60:1	2.74	16.2	5.20	28.7	9.00	45.5	12.7	80.6	21.5	125.
						.58	4.08	1.00	6.75	70:1	2.34	13.9	4.45	24.6	7.72	39.0				

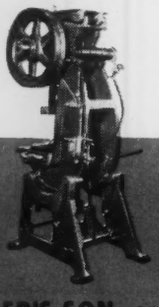
Ratings apply to both Standard Cone-Drive Speed Reducers and Standard Cone-Drive Gear Sets.

YOUR PRESSES *CAN* DO MORE FOR YOU!

It's a simple matter to get (1) SAFER operation, (2) more operator satisfaction and (3) more production from your presses. Just install Schrader Press Controls. Let them put compressed air to work for you—efficiently! Eliminate fatiguing leg movements, keep hands automatically away from danger zone. Thousands of Schrader Press Control Sets are in use in leading plants.

Contact your mill supply distributor or write for Catalog 9 containing details on the various types of Schrader Controls for presses. You'll save money in many ways!

1844 1947



PRESS CONTROLS

OTHER SCHRADER PRODUCTS FOR EFFICIENT AIR CONTROL
Air Valves 2,3,4-way • Air Operated Machine Controls
• Air Operated Press Controls • Quick Acting Couplers
• Blow Guns • Air Ejection Sets • Hydraulic Gauges

Schrader
PRODUCTS
CONTROL THE AIR

A. SCHRADER'S SON, Division of Scovill Manufacturing Company, Incorporated, BROOKLYN 17, N. Y.

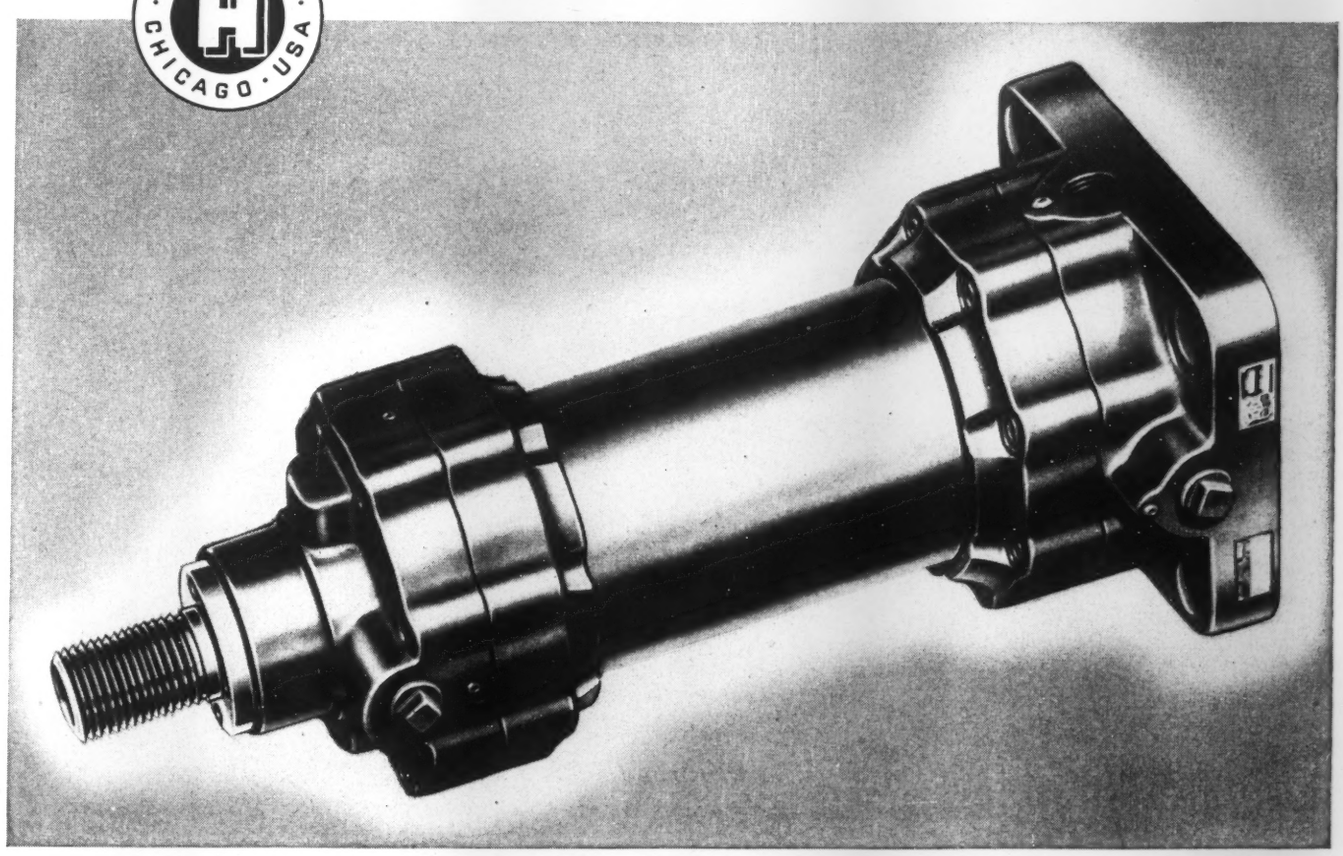
Something added

to HANNIFIN **HYDRAULIC CYLINDERS**

→ **7 AND 8 INCH BORES NOW STANDARD**

Nine standard mountings—1 to 8 inch bores —1000 lbs. service—stroke as specified— Write for information. Engineering service available in all industrial centers.

HANNIFIN MANUFACTURING COMPANY • CHICAGO 24



Specifications alone

DO NOT MAKE A WORM GEAR

Efficient operation and satisfactory trouble-free performance over long periods depend not only upon close adherance to engineering specifications but also upon the selection of materials, highly developed production techniques and high standards of quality control.

The excellence of De Laval worm gears is the result of a combination of all these factors, insuring a quality product that has been proven by the highly satisfactory performance of De Laval worm gears for nearly a quarter of a century.

DE LAVAL

WORM GEAR DIVISION

ATLANTA • BOSTON • CHARLOTTE • CHICAGO • CLEVELAND • DENVER • DETROIT
DULUTH • EDMONTON • GREAT FALLS • HAVANA • HELENA • HOUSTON • KANSAS CITY
LOS ANGELES • MONTREAL • NEW ORLEANS • NEW YORK • PHILADELPHIA
PITTSBURGH • ROCHESTER • ST. PAUL • SALT LAKE CITY • SAN FRANCISCO
SEATTLE • TORONTO • TULSA • VANCOUVER • WASHINGTON, D. C. • WINNIPEG

DE LAVAL STEAM TURBINE COMPANY • TRENTON 2, NEW JERSEY

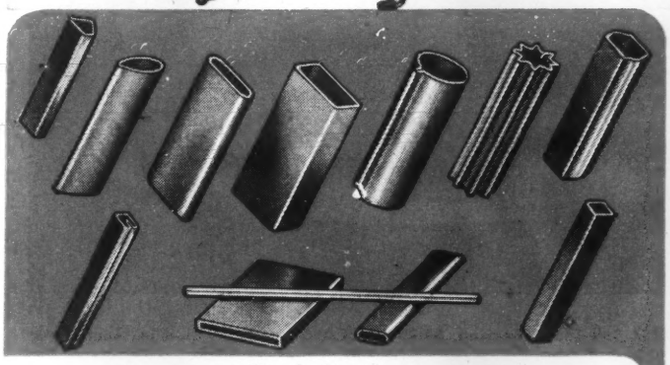
WG-3

TURBINES • HELICAL GEARS • WORM GEAR SPEED REDUCERS • CENTRIFUGAL PUMPS • CENTRIFUGAL BLOWERS AND COMPRESSORS • IMO OIL PUMPS

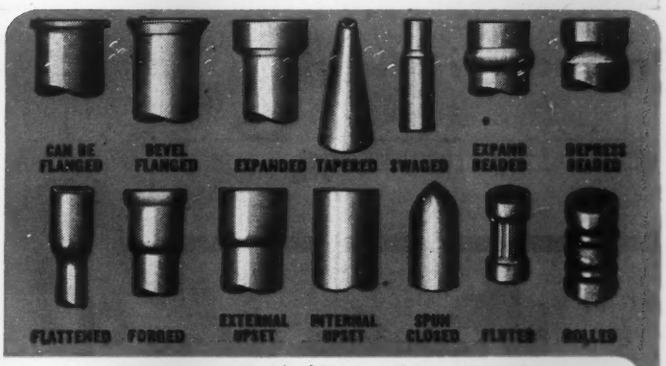
Wichita City Librar

It's Amazing How—

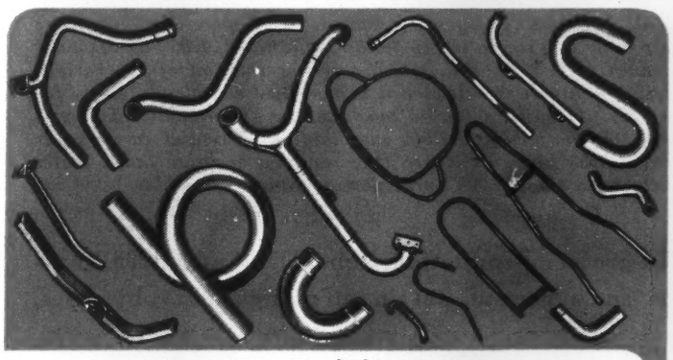
"Standard" electric welded steel tubing can simplify your designing, fabrication, and assembly processes in making finished products:



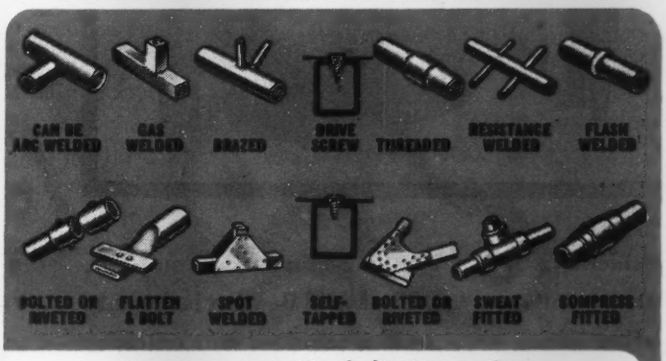
You can get *"Standard"* tubing in a variety of shapes, and in many sizes and gauges . . .



You can have *"Standard"* tubing further changed in cross section to meet your requirements . . .



You can have *"Standard"* tubing bent with equal ease in any direction . . .



You can assemble *"Standard"* tubing easily and quickly by any of these many methods.

Standardize with "Standard"—the quality tubing with a weld of the same uniform strength and physical characteristics as the tube wall itself—achieved by use of only flat-rolled steel coils meeting "Standard's" strictest physical and chemical specifications—by rolling only on "Standard's" latest equipment—to "Standard's" highly specialized requirements of forming and welding. Perhaps we can help you figure a more profitable production method.

★ *Complete Tube Stocks Maintained by* ★

STANDARD TUBE SALES CORP., One Admiral Ave., Maspeth, L. I., N. Y.
LAPHAM-HICKEY COMPANY, 3333 W. 47th Place, Chicago 32, Ill.
UNION HARDWARE & METAL CO., 411 E. First St., Los Angeles 54, Cal.
THE PACIFIC PIPE COMPANY., 160 Spear St., San Francisco 5, Cal.

THE STANDARD TUBE CO.

Detroit 3, Michigan

STANDARD

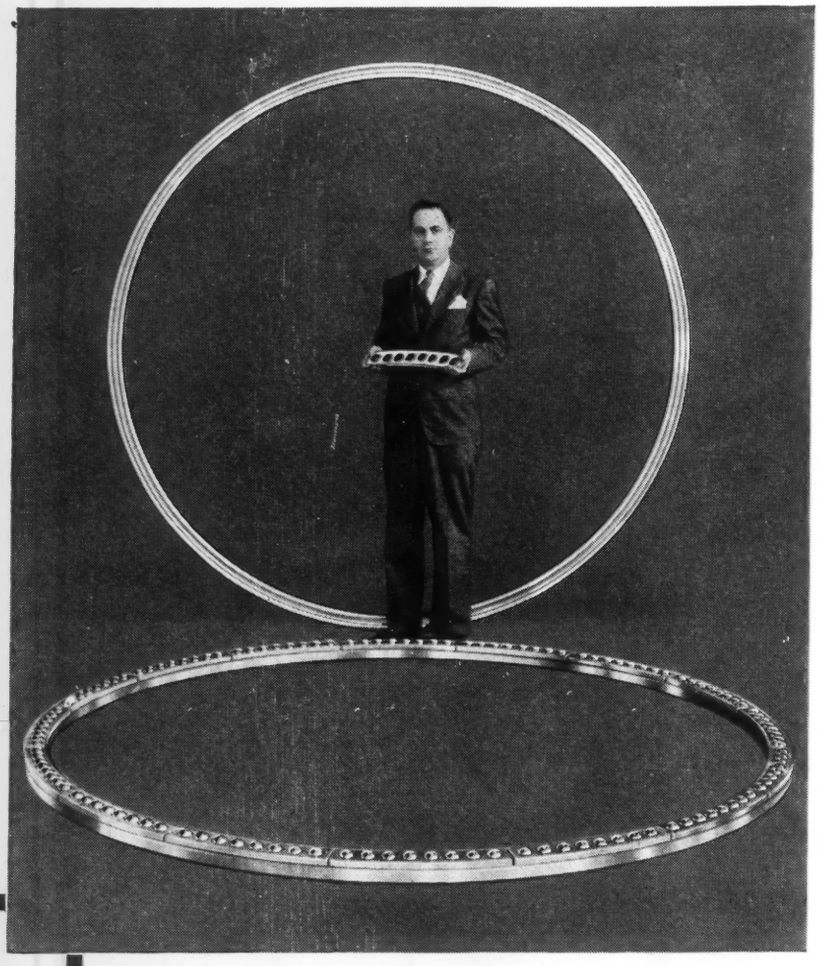
Welded Tubing — Steel Forgings

STANDARDIZE with "STANDARD"—It Pays

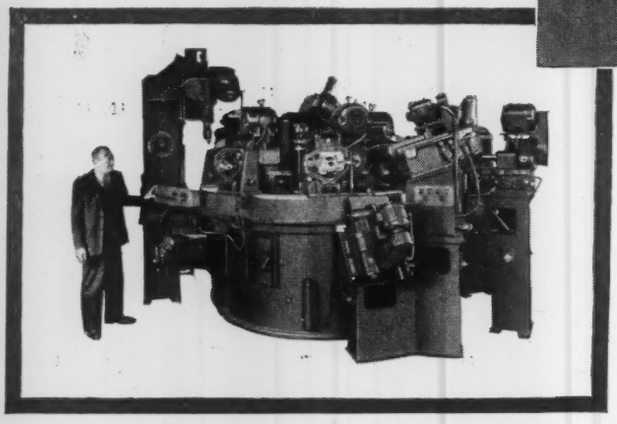
O. K. KAYDON BEARINGS

for

Leeromatic Precision Production Machines



KAYDON Ball Thrust Bearing, 81.996" x 87.000" x 3.750", used in "Leeromatic Six" and "Leeromatic Eight" automatic precision drilling machines manufactured by Lee Engineering Company, production engineers, Detroit.



The "Leeromatic Eight" is an 8-station automatic precision machine to drill, bore, mill and perform various other operations on a water pump body at a single set up, holding a limit of .0005" on diameter of pump shaft hole, and insuring proper relation of the various holes. When part is unloaded it is machined completely, ready for assembly. A similar 6-station machine, the "Leeromatic Six", produces 285 completely drilled automobile differential carriers per hour. KAYDON *Bearings insure true running, accurate index tables which make these .0005" precision operations possible.*

President C. S. Lee, of Lee Engineering Company, Detroit, wrote us: "... The KAYDON Bearing is the only bearing which gives us the required concentricity and load capacity giving accuracy of .0005" limit on the part produced, making possible the success of this type of machine."

Designers of modern machinery, striving to apply technological advances of the past several years to gain greater production, generally find KAYDON Bearings an important aid in attaining their objectives.

Counsel in confidence with KAYDON. Capacity available for all sizes and types of KAYDON Bearings ... and for atmospheric controlled heat treating, precision heat treating, salt-bath and sub-zero conditioning and treatment, microscopy, physical testing and metallurgical laboratory services.

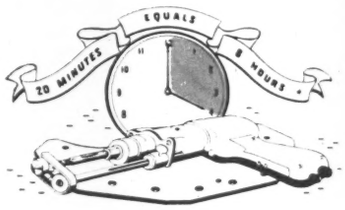
KAYDON *Types of Standard or Special Bearings:*

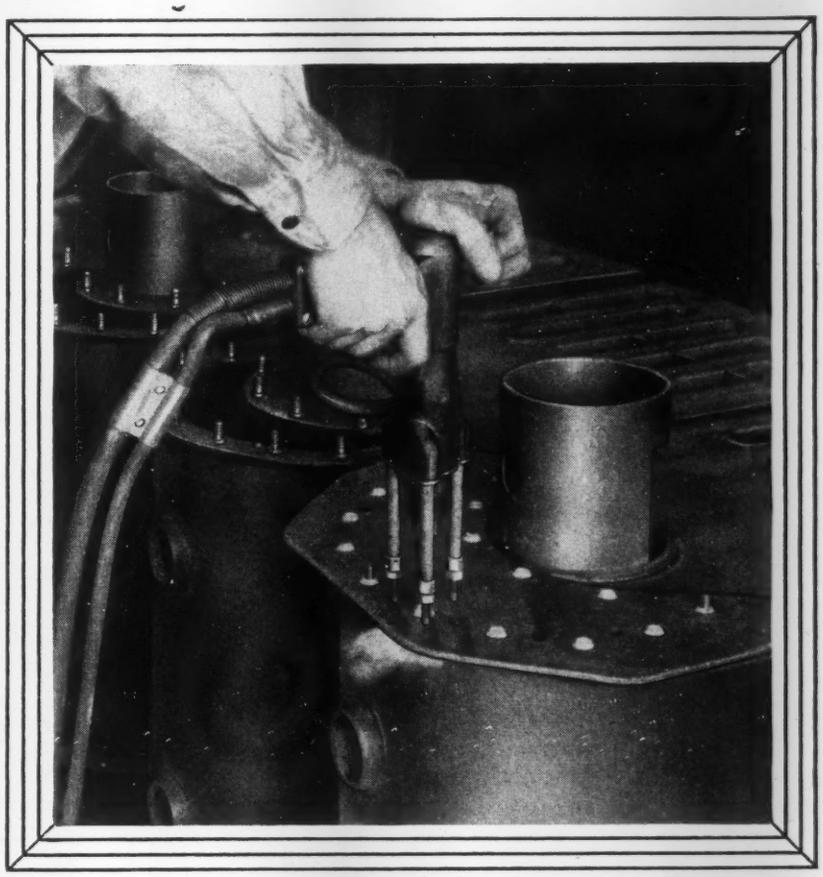
Spherical Roller • Taper Roller • Ball Radial
Ball Thrust • Roller Radial • Roller Thrust

THE KAYDON ENGINEERING CORP., MUSKEGON, MICH.

All types of Ball and Roller Bearings 4" bore to 120" outside diameter

Picture of a man doing a day's work in 20 minutes

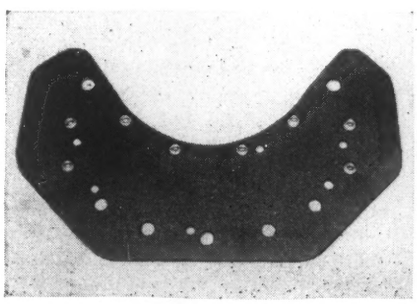




NELSON Automatic Stud welder installing studs at the rate of 3 a minute on "Fuelmizer" boilers manufactured by Arthur C. Bauman, Philadelphia.

It takes a total of 26 studs to secure the various covers on the "Fuelmizer" domestic heating boiler pictured above. Former stud installation required locating, center-punching, drilling, and either tapping and installing threaded studs or hand-welding bolts.

Six months ago, NELSON Automatic Stud Welding was adopted. Stud installation reached the rate of 3 per minute on water coil cover studs, and averaged 175 per hour for all applications. Approximately 10 minutes of stud welding saved 4 manhours per boiler!



SIMPLE TEMPLATES SPEED PRODUCTION—The template shown here accurately locates the 15 3/8" x 1" studs used to secure water coil covers on the "Fuelmizer." Studs for covers on the combustion chamber, economizer, and smoke box are located by centerpunching through the punched holes in the covers themselves.

NELSON Automatic Stud Welding reduces stud installation to one trigger-quick operation. The operator merely loads the stud and protective ferrule into the gun chuck, places the gun in welding position, and pulls the trigger. Weld cycle is automatically controlled; weld strength exceeds that of the stud, and all welds are uniform. Power is supplied by any suitable d.c. welding generator. The 5 lb. gun is fully portable, and handles NELSON studs from 1/8" through 3/4" in diameter, up to 8" long.

Savings in production time and cost are not the only advantages of NELSON stud welding on the "Fuelmizer" boiler. Because no stud holes are drilled through the shell, installation is "leak-proof." Because stud welding can be done in any position, and anywhere in the shop, costly handling of the boiler assemblies is substantially reduced. It all adds up to a better job, done faster—at savings *you* can't afford to miss!

Investigate NELSON Automatic Stud Welding—now. Both manual guns and high-capacity NELSON production units are readily available at nominal cost. Complete information—and competent application engineering help, if you need it—are yours for the asking. Just write or wire:

NELSON SALES CORPORATION
2703 Toledo Avenue

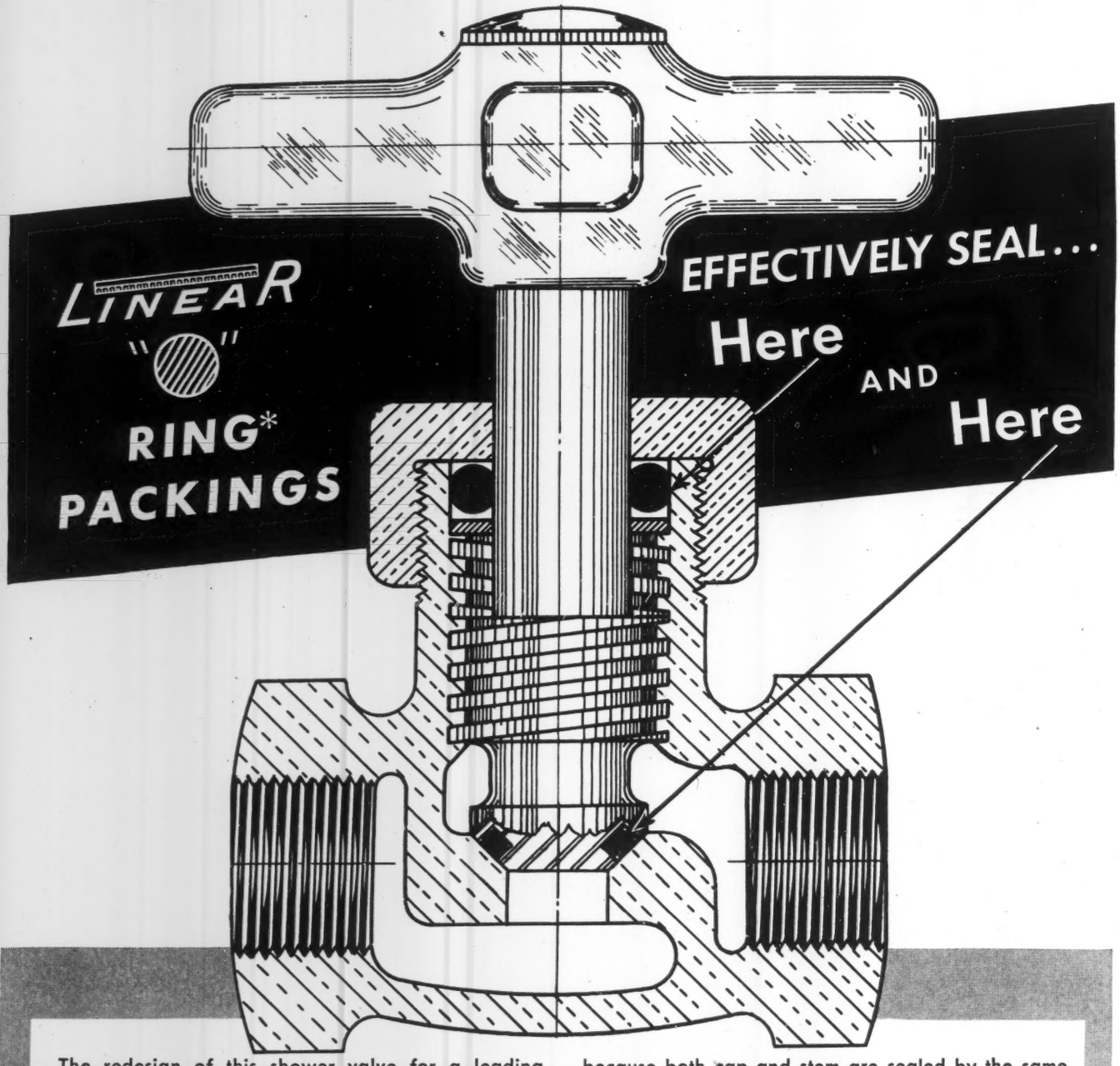
LORAIN, OHIO

Representing

Nelson Stud Welding Corporation Lorain, Ohio	Nelson Specialty Welding Equipment Corporation San Leandro, California

NELSON

TRADEMARK



The redesign of this shower valve for a leading plumbing fixture manufacturer is an outstanding example of the adaptability of Linear "O" Ring Packings to a wide variety of design applications.

Not only is the new design more efficient but it is more compact — and packing wear and replacement are materially reduced. The Linear "O" Ring provides a more effective seal; requires no tools to install since no wrench pressure on the packing nut is needed to maintain the seal; eliminates the cap gasket because both cap and stem are sealed by the same "O" Ring; and permits uniform handle torque from one valve to the next since the "O" Ring pressure against the shaft is constant and non-adjustable.

The valve and seat combination, too, have advantages characteristic of "O" Rings. They are: No retaining screw is needed; and the "O" Ring cannot be damaged by over-tightening, thereby, increasing the life of the packing and assuring drip-free faucets with less packing replacement.

* Covered by Christensen United States Patent No. 2,180,795; all "O" Rings sold by Linear are manufactured under royalty agreement with patentee.

Our more than 40 years' experience in the design and application of mechanical packings for every purpose is at your service. Our engineering facilities are available to help you with your design problems. Write

LINEAR

LINEAR
INCORPORATED

OVER FORTY YEARS PACKING EXPERIENCE

Executive Offices and Factory
STATE ROAD and LEVICK STREET—PHILADELPHIA 35, PENNA.

As the white outline indicates, a standard unit of much greater frame size would be required to do the work of Speedaire.

Photo by courtesy of General Die Casting Corp., Oakland, Calif.

SPEEDAIRE permits compact design

THE increased capacity of Speedaire and the minimum space required for its installation enabled the builder of this Aluminum Die Casting Machine to design a more compact and efficient machine. In addition, Speedaire cost 16% less than a conventional worm-gear unit, saving $39 on each drive.

Speedaire is Cleveland's new fan-cooled worm-gear speed reducer. Because it is fan-cooled, Speedaire will do more work —will deliver up to *double the horsepower* of standard worm units of equal frame size, at usual motor speeds. It can be installed economically on many applications where other types have been used heretofore—giving you the advantages of a compact right-angle drive. Speedaire gives the same long, trouble-free service characteristic of all Clevelands.

For full description, send for Catalog 300. The Cleveland Worm & Gear Company, 3265 East 80th St., Cleveland 4, Ohio.

Affiliate: The Farval Corporation, Centralized Systems of Lubrication. In Canada: Peacock Brothers Limited.

CLEVELAND
Worm Gear
Speed Reducers

Wear-resistant Ampco Metal protects glass-making machines against production-interrupting breakdowns

*"The manufacture of glass containers requires more from a machine than any other automatic production process," according to engineers at the Hartford Empire Company, Hartford, Conn., leading producer of glass-making machinery. "Equipment must run 24 hours-a-day, month after month except for mold and job changes. Add high temperatures, constant vibration and stress . . . and you have the ever-present threat of a machine breakdown.

"We use Ampco Metal for bushings, bearings, gears, and other vital parts subject to this punishment. Ampco Metal has the *guts* for hard wear and it won't corrode. It gives an extra margin of safety. We install Ampco Metal parts and forget them!"

Solve Your Metal Problems too, with Ampco Metal

Ampco Metal is the modern aluminum bronze — characterized by great strength, controlled hardness, corrosion resistance, and superior bearing qualities. Ampco Metal is available in seven grades and several modifications—can be produced by centrifugal or sand casting, extruding, or forging.

Write for bulletins!

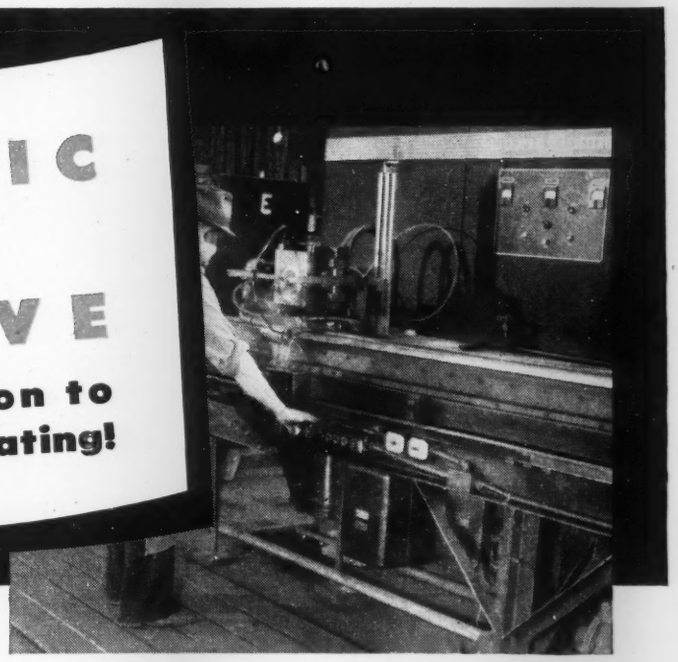
AMPCO Metal
The Metal without an Equal

Ampco Metal, Inc.
Department MD-2 Milwaukee 4, Wis.
Field Offices in Principal Cities

AD-27

AUTOMATIC ELECTRONIC FEED DRIVE

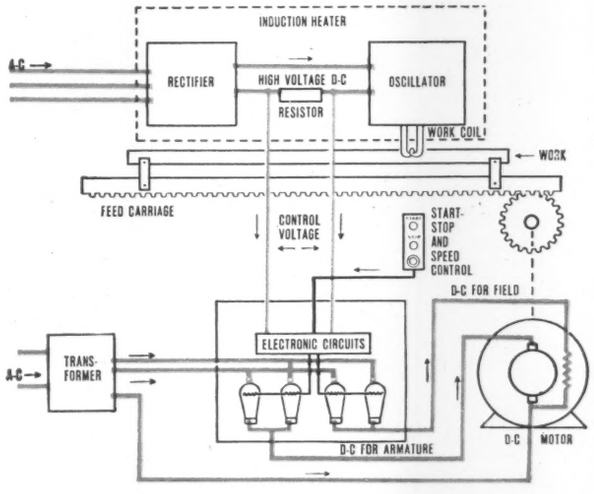
...brings new precision to continuous induction heating!



G-E Thy-mo-trol matches feed drive speed with heater performance to maintain more uniform quality.

Automatic speed matching with G-E Thy-mo-trol drive continues to make news for machine designers! First, it was matching the rate of feed with the depth of cut on a milling machine. Then, it was keeping conveyor speeds in step with the output of an extruding machine.

AND NOW . . . it's been put to work on an electronic induction heater, maintaining tight quality control! All of this proves a point—where precise, automatic speed matching is required, Thy-mo-trol drive is a wise choice.



Control of this induction heater's feed drive is correlated with the amount of load placed on the heater work coil. Changes in the current of the heater oscillator are reflected as voltage change across a resistor connected in the heater circuit. This voltage adjusts the speed of the motor by controlling the thyratron tubes in the Thy-mo-trol panel. Thus, the speed of the feed motor almost instantaneously follows variations in the load current.

INDUCTION HEATER IS PROOF!

On continuous induction heating, the ability to vary the travel speed is very important in producing uniform heat treatment of parts. Best results can not be obtained with a constant feed rate, because in order to get the desired depth of heat penetration, the speed must be varied as the size of the part varies. Some way of readily adapting the feed speed to the size of part is needed—and Thy-mo-trol drive provides the ideal way. The Thy-mo-trol circuit is connected to the load circuit of the induction heater. In this way, Thy-mo-trol automatically changes the speed of the carriage to maintain constant power output, and thus, uniform control of hardened area. Parts move at speeds which will assure correct heating, rejects are reduced, and high-quality is maintained—because of Thy-mo-trol drive.

INVESTIGATE THY-MO-TROL DRIVE NOW!

Speed matching is but one of the many functions a Thy-mo-trol drive can perform. Some others are stepless control of speed over a wide range; holding constant speed under changing loads; and smooth, rapid, constant-current acceleration. Drives in ratings from $\frac{1}{8}$ to 25 hp are now available. Why not get the facts on G-E Thy-mo-trol before you make a decision on your next drive? Your local G-E office will be glad to discuss it with you. *Apparatus Department, General Electric Company, Schenectady 5, N. Y.*

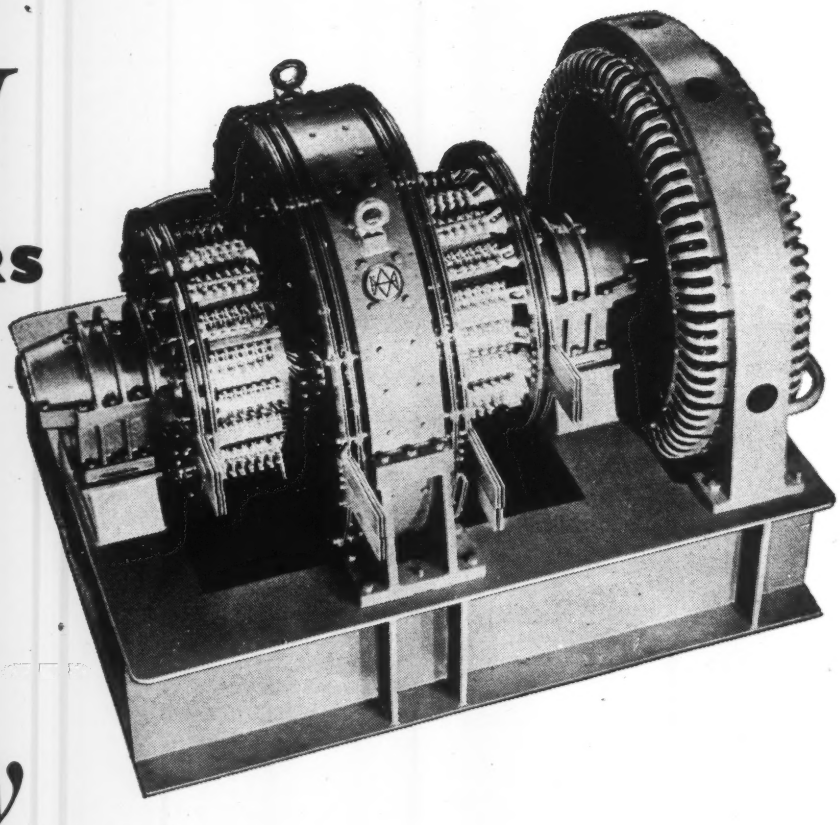
GENERAL ELECTRIC

676-195-8910

THY-MO-TROL DRIVE

H-VW-M

GENERATORS



FEATURING

Versatility

FEATURES built into H-VW-M generators qualify them for many types of service, appeal alike to electroplaters, anodizers, electrotypers, producers of electrolytic chemicals, metal refiners. Among these features are:

Core-ventilated laminated armatures of non-aging silicon steel • Low-loss laminated fields • Generous sleeve-type bearings with oil-rings — for long, quiet operation, easy maintenance • Wide voltage range or stable voltage characteristics, as needs require.

A 6-volt, 15,000 ampere H-VW-M Motor Generator Set is shown above.

H-VW-M generators are built in standard voltage ratings of 6, 9, 12, 15, 18, 25, 30, 40, 50; in ratings up to 25,000 amperes.

Write for H-VW-M Generator Bulletin

HANSON-VAN WINKLE-MUNNING CO. · MATAWAN, NEW JERSEY, U.S.A. · SINCE 1820

2391

HANSON-VAN WINKLE-MUNNING COMPANY

MATAWAN, NEW JERSEY

Manufacturers of a complete line of electroplating and polishing equipment and supplies

Plants: Matawan, New Jersey • Anderson, Indiana

Sales Offices: Anderson • Chicago • Cleveland • Dayton • Detroit
Grand Rapids • Matawan • Milwaukee • New Haven • New York • Philadelphia
Pittsburgh • Rochester • Springfield (Mass.) • Stratford (Conn.) • Syracuse

"The impossible takes a little longer"...this is one way of saying that the draftsman lets no out-worn conceptions restrict his creative ideas. Yet without his specialized technique for expressing ideas on paper, the designs he creates could scarcely be turned into substance. As the draftsman relies on his own hands and eyes, he calls likewise on his drafting instruments to serve him functionally. So integral a part of his technique do they become, they are virtually his partners in creating.

For 78 years Keuffel & Esser Co. drafting equipment and materials have been partners, in this sense, in creating the greatness of America, in making possible our fleets of ships, our skyscrapers, our overwhelming weight of armor on the battlefield...So universally is K & E equipment used, it is self-evident that every engineering project of any magnitude has been completed with the help of K & E. Could you wish any surer guidance than this in the selection of your own "drafting partners"?

Because of their balance, smooth action and responsiveness to your hand, you will find that using MINUSA* Drawing Instruments is almost as natural as breathing. Their legs are round and tapered, without the harsh feel of sharp corners. Joints are firm, snugly fitted, and satin-smooth in operation. Yet these instruments are strong and durable, for their precision will outlast years of continuous use. For complete data on MINUSA* Drawing Instruments, write on your letterhead to Keuffel & Esser Co., Hoboken, N. J.

*REG. U. S. PAT. OFF.

partners in creating

HydrOILic FLUID MOTORS

give you

SHOCK-PROOF action on sudden starts and stops . . . STEPLESS SPEED CONTROL in either direction . . . INSTANT SPEED-UP for rapid traverse needs!

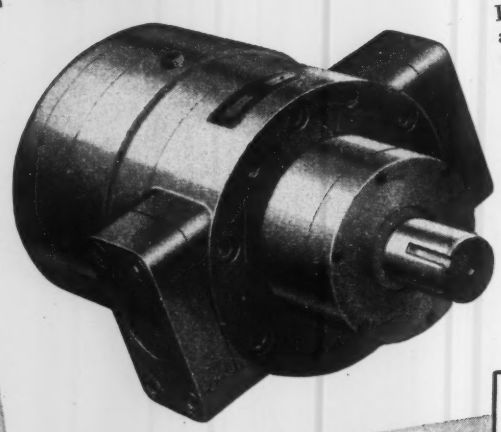
● The "Floating Drive" of HydrOILic Fluid Motors eliminates wear and tear from sudden starts, stops and reversals! There are no mechanical linkages of any kind between the driving and driven elements—yet they remain in *constant pressure contact* at all times. Motors are self-starting when pressure is applied. 3 and 5 hp sizes! Three types of brackets provide for any mounting arrangement.

The speed-control valve assembly can be used with HydrOILic Fluid Motors if desired. Permits quick, easy presetting of the motors at any rpm within their capacity. For high efficiency on rapid-traverse needs, they are equipped with a plunger device that permits instant acceleration from any preset speed to full speed for any desired length of time. Motors resume preset speed instantly when plunger is released.

Geared head drives are available for both the 3 and 5 hp HydrOILic Fluid Motors. Gear ratios of 3:1, 1:3, 1.5:1 and 1:1.5 provide a wide range of operating speeds. Write today for complete information!

PUMPS . . . another HydrOILic achievement

Combining High Pressure with High Volume Delivery



HydrOILic pumps combine *speed* with *power* in a degree never before attained . . . operate quietly at all pressures . . . feature remarkably simplified construction and operation . . . bring a new conception of long service-life and low maintenance cost.

These axial piston, constant-displacement pumps feature a newly developed pressure-equalization principle which eliminates the "scream" or noise produced by ordinary hydraulic pumps. Actual tests prove they will operate continuously at 1200 rpm, delivering pressures of 3500 psi with volumetric efficiencies of 95% *or more.*

Denison HydrOILic Pumps in this 3500 series are available in three models, delivering volumes of 6, 17, and 32 gpm. Write for complete details.

THE **DENISON** ENGINEERING COMPANY
1156 Dublin Rd., Columbus 16, Ohio

DENISON EQUIPMENT *in* APPLIED HydrOILics

FACTS EVERY GEAR ENGINEER WILL WANT

NEW

Anyone concerned with gears for heavy-duty or light-duty mechanical or electrical applications will find this new Gear Booklet full of helpful information.

Contains a concise version of all the pertinent facts about Lamicoid laminated plastic gear stock. Tells where and how to use this material to gain its many advantages. Explains methods of design, fabrication and installation as well as hints on the care of Lamicoid gears. Condensed information never before published in a single booklet.

Also described in detail is the unusual combination of physical, chemical and electrical properties of Lamicoid—such as its dimensional stability, resilience and high strength . . . resistance to moisture, abrasion, high temperatures and most corrosive media.

If you would like a free copy of this new Manual for your reference, fill out and mail coupon immediately.

MICA INSULATOR COMPANY

Dept. 20, Schenectady 1, N. Y.

SALES OFFICES: Boston • Chicago • Cincinnati • Cleveland Detroit • New York • St. Louis • Philadelphia • Rochester Western Fiberglas Supply, Ltd., San Francisco and Los Angeles, Calif. **FABRICATORS:** Lamicoid Fabricators, Inc., Chicago, Ill. Insulating Fabricators, Inc., Watertown, Mass. • Insulating Fabricators, Inc., New York City • Bakoring, Inc., Houston, Texas

Mica Insulator Company
Dept. 20, Schenectady 1, New York

Gentlemen:
Please send my free copy of your new 16-page Manual on Lamicoid Gear Stock.

Name_____

Position_____

Company_____

Address_____

City_____ State_____

Design for

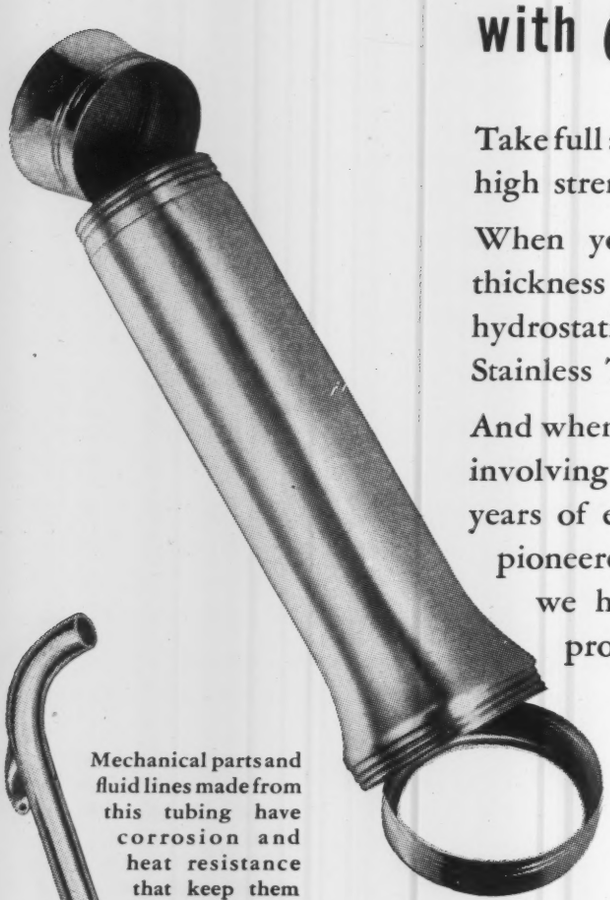
✓ LOWER UNIT COSTS
✓ MAXIMUM SERVICE LIFE

with *Carpenter* stainless tubing!

Take full advantage of the corrosion and heat resistance plus high strength/weight ratio of Carpenter Stainless Tubing.

When you need Stainless Tubing with uniform wall thickness throughout each length—tubing that is 100% hydrostatically tested—be sure your orders specify *Carpenter* Stainless Tubing.

And when you want help with your engineering problems involving Stainless Tubing, make use of Carpenter's 20 years of experience. Ever since the days when Carpenter pioneered the development of Welded Stainless Tubing, we have been putting our know-how to work on problems similar to yours. Drop us a line today.



Mechanical parts and fluid lines made from this tubing have corrosion and heat resistance that keep them on the job.

Consumer goods like this flashlight case can be produced at less cost because of the *uniform walls* of Carpenter Stainless Tubing.

CARPENTER STAINLESS TUBING for

- —Strength and Rigidity
- —Weight Savings
- —Corrosion Resistance
- —Heat Resistance
- —Accuracy
- —Fabricating Savings
- —Longer Service Life
- —Sales Appeal

POLISHED INSIDE *Carpenter* Stainless Tubing

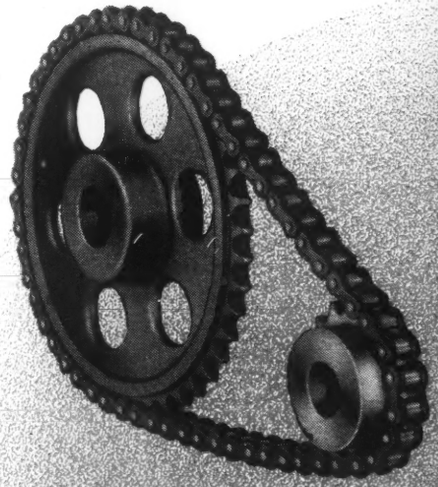
Where smooth interior surfaces are mechanically desirable—or where they are required in chemical or food processing—check the ways you can save with Carpenter Polished Inside Stainless Tubing. This tubing is available in a complete range of analyses and sizes.

THE CARPENTER STEEL COMPANY • Welded Alloy Tube Division • Kenilworth, N. J.

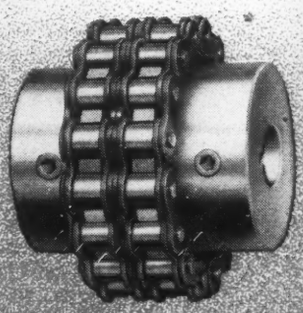
Carpenter
STAINLESS TUBING

The Answer to Mechanical Power Transmission Problems . . .

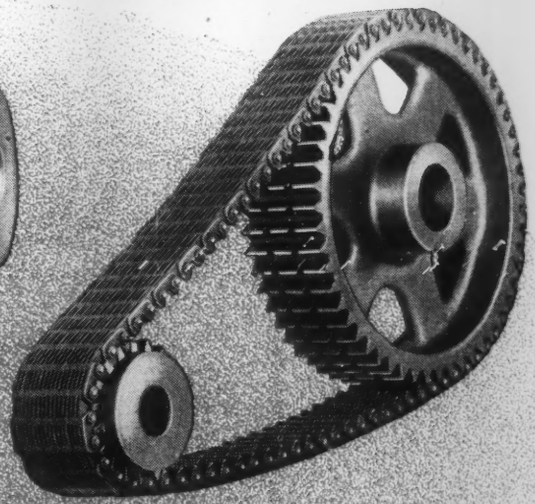
Throughout industry, machinery and equipment manufacturers use MORSE ROLLER and SILENT CHAIN DRIVES, FLEXIBLE COUPLINGS, FREE WHEELING, INDEXING and FRICTION CLUTCHES.



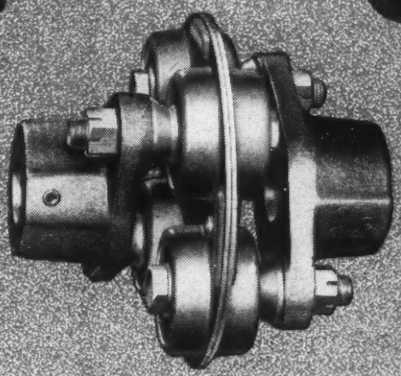
ROLLER CHAIN AND SPROCKETS — High-Quality, Precision-Built.



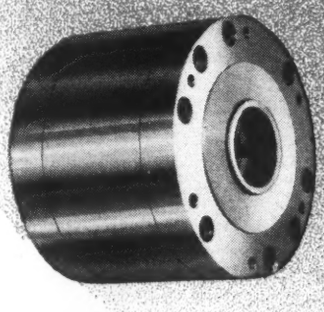
ROLLER CHAIN COUPLING — Easily installed and aligned.



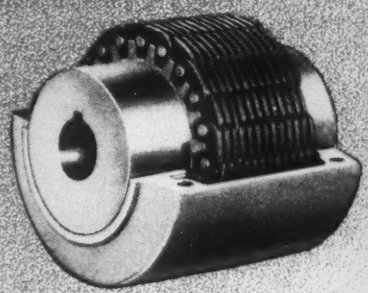
SILENT CHAIN AND SPROCKETS — Up to 5,000 horsepower. Up to 8,000 ft. per minute.



MORFLEX COUPLING — Isolates vibration for smooth power transmission



FREE WHEELING CLUTCH — Instant Engagement and Release.



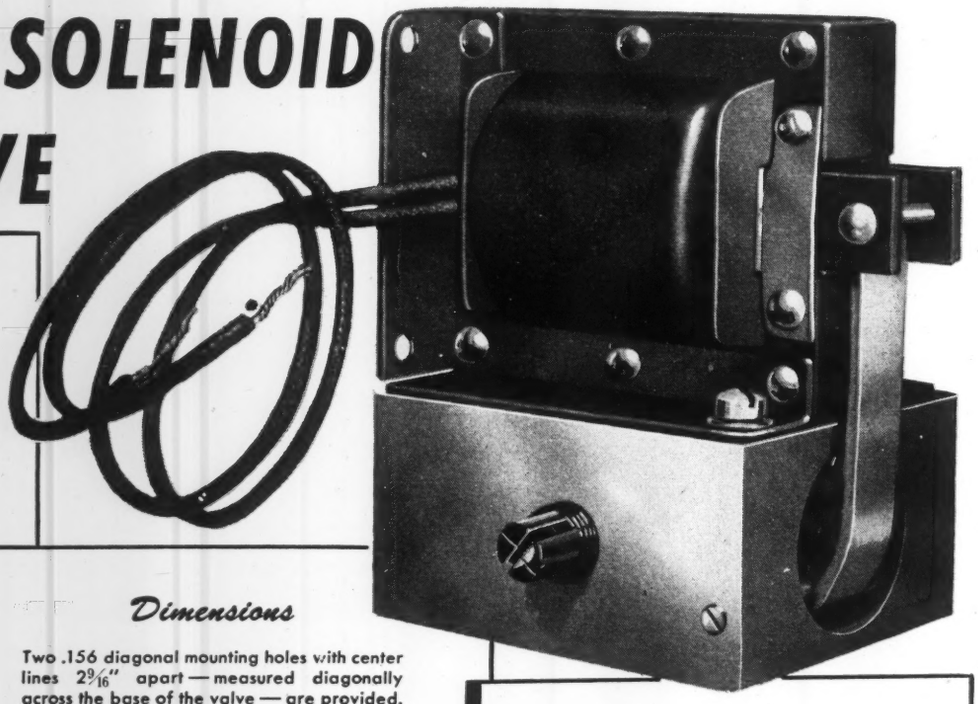
SILENT CHAIN COUPLING — Flexibility in a rugged, all-steel design.

MORSE CHAIN COMPANY, DETROIT 8, MICHIGAN • ITHACA, N. Y.

MORSE MECHANICAL POWER TRANSMISSION PRODUCTS

A PRODUCT OF B-W BORG-WARNER

ELECTROL'S NEW 110 VOLT AC TWO-WAY SOLENOID VALVE



Features

110 Volt, 60 Cycle AC continuous duty solenoid. Current rating .3 amperes when solenoid completely energized.

Operating pressures 0 to 1500 PSI — higher if desired.

Port sizes: ⅛", ¼", ⅜" and ½" N.P.T.

Primarily for use in oil, but can be made for use in other types of fluid.

Dimensions

Two .156 diagonal mounting holes with center lines $2\frac{9}{16}$" apart — measured diagonally across the base of the valve — are provided. The ports, one on each side, are clearly marked for correct installation.

The valve measures $3\frac{5}{16}$" high by 2" wide by 3½" maximum length. (These dimensions are slightly greater in the ⅜" and ½" pipe sizes.)

All exposed parts are fully protected from corrosion.

Construction

Valve body of heat treated aluminum alloy which houses hardened and ground steel poppet and seat.

The poppet and seat form a balanced valve and insures long, reliable service.

The "O" ring seals are of synthetic rubber of standard design and size.

A heavy duty 100 Volt 60 Cycle AC solenoid is mounted on top of the aluminum alloy valve body and the solenoid core motion is transmitted to the valve plunger by means of a mechanical lever.

This construction gives the solenoid a mechanical advantage and insures positive, accurate operation.

Two ten-inch lead wires are provided for easy installation.

The entire construction is compact, sturdy and reliable.

This new ELECTROL valve is designed for continuous duty and can be used 24 hours a day. It is a complete, efficient unit for use in all types of machines where continuous duty is required. Also made in comparative operating pressures and port sizes with voltage ranging from 12-24 volts DC.

For further information, write or phone today.

ELECTROL *INCORPORATED*

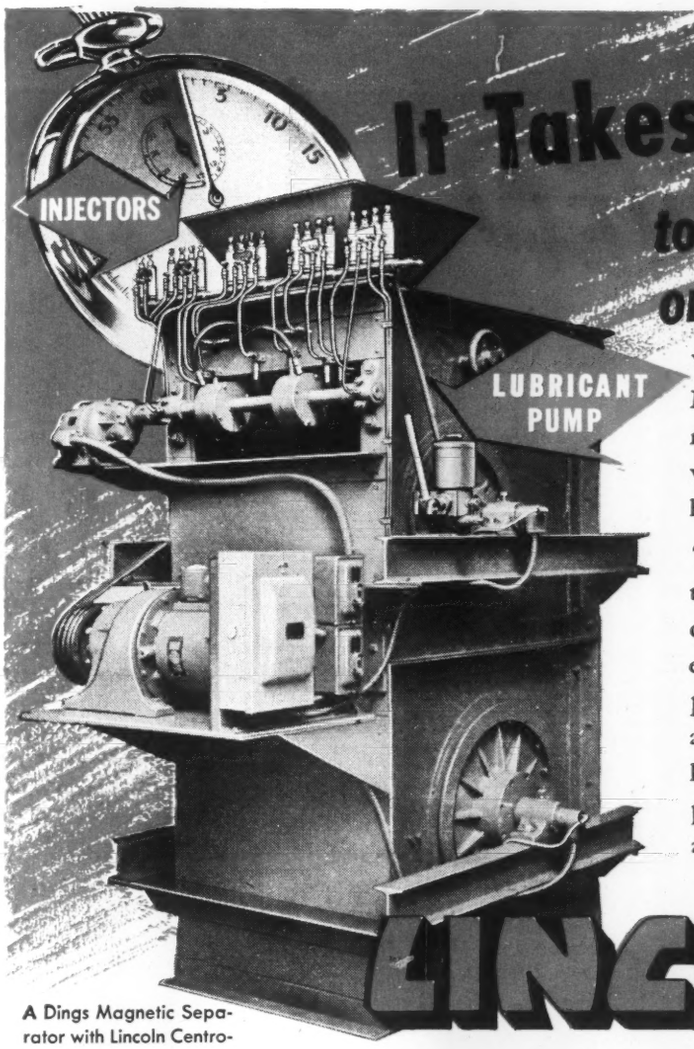
FOR BETTER HYDRAULIC DEVICES

KINGSTON, NEW YORK

CYLINDERS • SELECTOR VALVES • FOLLOW-UP VALVES • CHECK VALVES

RELIEF VALVES • HAND PUMPS • POWERPAKS • OLEO STRUTS • SOLENOID VALVES

ON-OFF VALVES • SERVO CYLINDERS • TRANSFER VALVES • CUT-OUT VALVES



A Dings Magnetic Separator with Lincoln Centro-Matic System.

It Takes Only SECONDS to LUBRICATE every Bearing on this MACHINE...

When a manufacturer includes a Lincoln Centro-Matic System to lubricate the bearings on the machines which he produces, he provides the user with a fast, thorough lubricating system and assures him of top operating efficiency.

There is a Lincoln Centro-Matic System to meet the requirements of each particular machine. It consists of a pump, an injector of suitable size for each bearing, a single supply line to connect the pump to the injectors, and a tubing connection from an injector to each bearing. Pumps are available for hand, air or electric operation. The electric and air pumps may be equipped with a time clock for full automatic operation if desired.

LINCOLN

Single line

CENTRO-MATIC LUBRICATING SYSTEMS

used on Hundreds of Machines...

- ☐ Angle Shears
- ☐ Agitators
- ☐ Bottling Machinery
- ☐ Brick Presses
- ☐ Boats
- ☐ Bolters
- ☐ Boring Machines
- ☐ Bar Mills
- ☐ Bar Straighteners
- ☐ Back Geared Presses
- ☐ Brake Presses
- ☐ Blast Furnaces
- ☐ Cranes
- ☐ Crimpers
- ☐ Centerless Grinders
- ☐ Candy Machinery
- ☐ Cutters
- ☐ Chemical Machinery
- ☐ Cold Roll Mills
- ☐ Conveyors
- ☐ Coal Loaders
- ☐ Coke Quenching Cars
- ☐ Chip Stokers
- ☐ Crushers
- ☐ Caramel Cutters
- ☐ Cookers
- ☐ Coilers
- ☐ Dry Presses
- ☐ Drying Machines
- ☐ Duplicators
- ☐ Die Casters
- ☐ Draw Benches
- ☐ Electric Shovels
- ☐ Forging Machines
- ☐ Forming Presses
- ☐ Filter Presses
- ☐ Filtering Equipment
- ☐ Grain Presses
- ☐ Grinders
- ☐ Hydraulic Presses
- ☐ Lathes
- ☐ Locomotives
- ☐ Mixers
- ☐ Mine Tipples
- ☐ Metal Reclaimers
- ☐ Pasting Machinery
- ☐ Punch Presses
- ☐ Printing Presses
- ☐ Plastic Presses
- ☐ Processing Machinery
- ☐ Packaging Machinery
- ☐ Plate Shears
- ☐ Rubber Mills
- ☐ Rolling Mills
- ☐ Roll Squeezers
- ☐ Separators
- ☐ Steam Shovels
- ☐ Spacing Machines
- ☐ Starch Bucks
- ☐ Screw Conveyors
- ☐ Slab Mills
- ☐ Shears
- ☐ Tube Coiling Machinery
- ☐ Tow Boats
- ☐ Tin Plate Machines
- ☐ Veneer Dryers
- ☐ Wall Board Machines

Engineering Service

Lincoln Engineering Company maintains a staff of experienced lubrication engineers prepared to assist you with lubricating problems. Write us, enclosing a blueprint or specifications of the machine, and we will recommend the type of Centro-Matic System best suited.

Lincoln Engineering Company • St. Louis 20, Mo.

Please give me information on Centro-Matic Systems for (type of machine) _____

Please send me literature on Centro-Matic Systems ☐.

Name _____

Firm _____

Address _____

City _____ State _____

MD 847-3

"FOUND"

MANY NEW USES FOR

HANSEN
COUPLINGS

AIR, OIL—GREASE COUPLING

OXYGEN COUPLING

ACETYLENE COUPLING

Hardly a day passes that adaptations to new uses for Hansen couplings are not found—many being discovered right in the field.

The possibilities of Hansen Couplings are unlimited because of their simplified design, adaptability, and remarkable performance. They can be used anywhere, within their wide range of standard sizes, on anything that handles air, oil, grease, oxygen or acetylene—and will handle pressures from ounces to 10,000 pounds.

To connect a Hansen hose coupling, you merely push plug into socket—to disconnect, slide the sleeve back with your thumb. In both cases, flow is immediately and automatically turned on or off. No time wasted, no losses.

FOR OXYGEN ACETYLENE AIR, GASOLINE OIL, GREASE STEAM

The adaptability of Hansen Couplings to so many different uses is the best possible evidence of their correct design. Our representatives will be glad to discuss with your engineers the possibilities and advantages of Hansen Couplings.

Send for illustrated catalog on the complete Hansen industrial line.

REPRESENTATIVES

New England States:
A. D. GEIGER, Belmont, Mass.

Eastern, Southern States:
B-R ENGRG. CO., Baltimore, Md.

Northern Ohio:
F. & W. URSEM CO., Cleveland, O.

Southern Ohio, West Va., Ky.
STEINHAGEN AIRLINE PRODUCTS, Dayton, O.

Northern Ill., Eastern Iowa:
NORRIS ENGRG. CO., Chicago, Ill.

Indiana, Wisconsin:
NEFF ENGRG. CO., Ft. Wayne, Ind.

Central Western States:
JOHN HENRY FOSTER CO., St. Louis, Mo., Minneapolis, Minn.

Western, Southwestern States:
BURKLYN CO., Los Angeles, Calif.

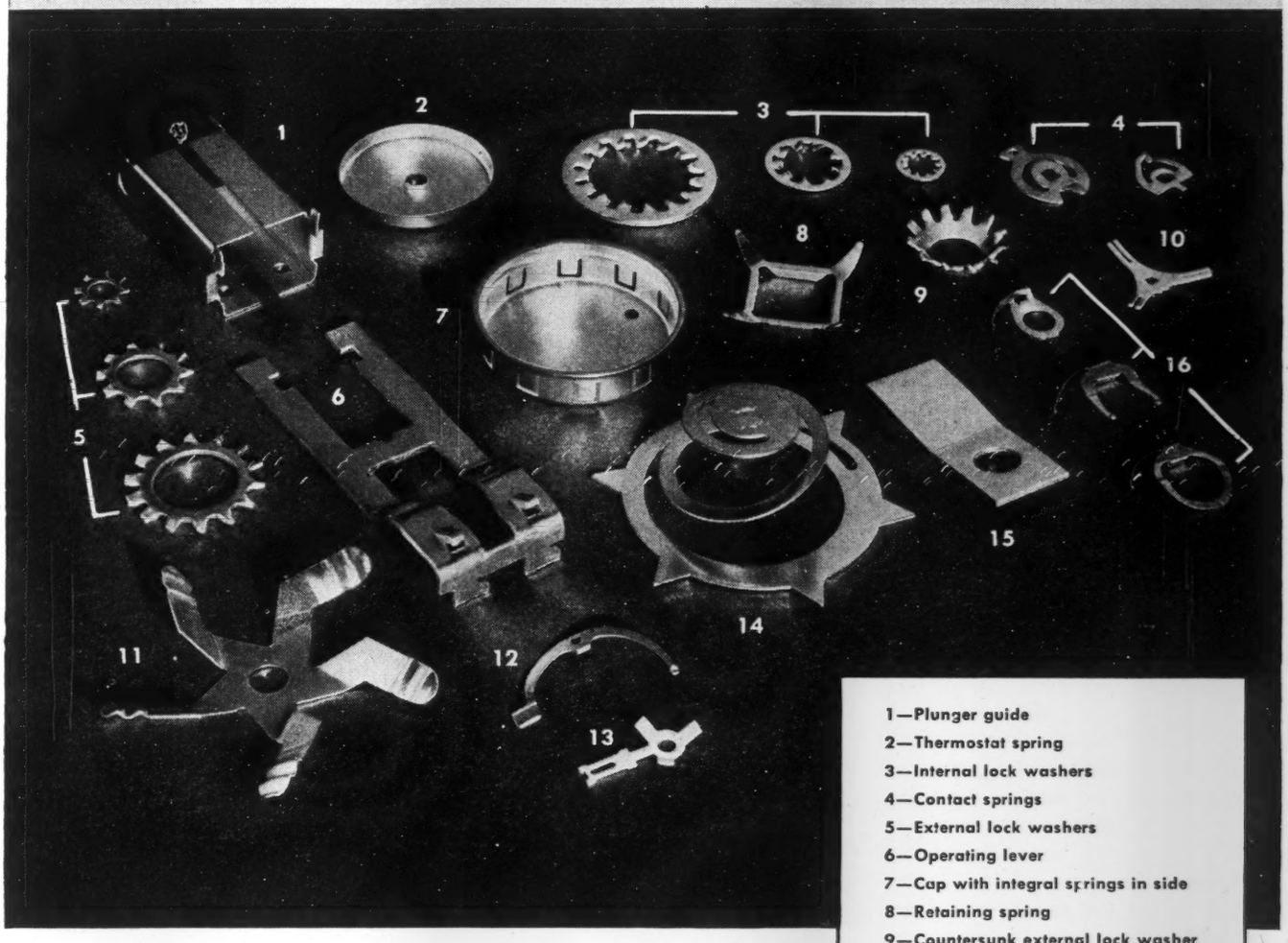
Northern Calif., Nevada:
H. E. LINNEY CO., Oakland, Calif.

Michigan:
WM. H. NASH CO., Detroit, Mich.

THE HANSEN MANUFACTURING CO.

1786 EAST 27th STREET • CLEVELAND 14, OHIO

REVERE PHOSPHOR BRONZES
OFFER MANY ADVANTAGES



1—Plunger guide
2—Thermostat spring
3—Internal lock washers
4—Contact springs
5—External lock washers
6—Operating lever
7—Cap with integral springs in side
8—Retaining spring
9—Countersunk external lock washer
10—Pressure spring for capacitor
11—Five-contact spring
12—Contact spring for radio part
13—Pressure spring and terminal
14—Involute spring
15—Contact point for solenoid
16—Contact springs
—made of Phosphor Bronze strip supplied by Revere

STRENGTH — Resilience — Fatigue Resistance — Corrosion Resistance—Low Coefficient of Friction—Easy Workability—are outstanding advantages of Revere Phosphor Bronzes, now available in several different alloys.

In many cases it is the ability of Phosphor Bronze to resist repeated reversals of stress that is its most valuable property. Hence its wide employment for springs, diaphragms, bellows and similar parts. In addition, its corrosion resistance in combination with high tensile properties render it invaluable in chemical, sewage disposal, refrigeration, mining, electrical and similar applications. In the form of welding rod, Phosphor Bronze has many advantages in the welding of copper, brass, steel, iron and the repair of worn or broken machine parts. Revere suggests you investigate the advantages of Revere Phosphor Bronzes in your plant or product.

REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

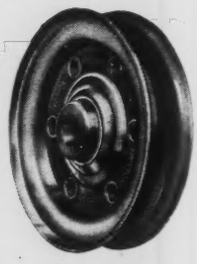
230 Park Avenue, New York 17, New York

Mills: Baltimore, Md.; Chicago, Ill.; Detroit, Mich.; New Bedford, Mass.; Rome, N. Y.—Sales Offices in Principal Cities, Distributors Everywhere.

•

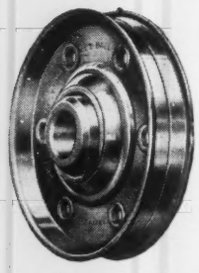
Listen to *Exploring the Unknown* on the Mutual Network every Sunday evening, 9 to 9:30 p.m., EST.

NICE
BALL BEARINGS
and
other
ANTI-FRICTION PRODUCTS



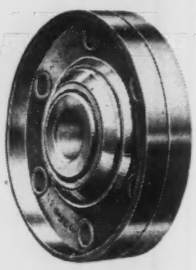
SERIES 2000 SHEAVES

Pressed Steel Ball Bearing Sheaves for rope, wire rope and special uses.



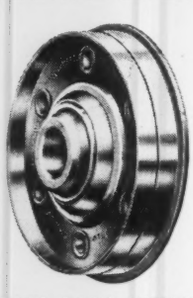
SERIES 2100 WHEELS

Wheels—Pressed Steel Ball Bearing—for flat chain or belt application and other uses.



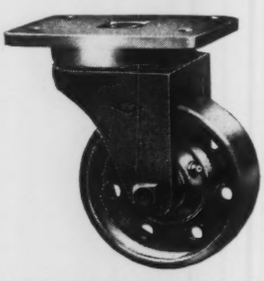
SERIES 2200 WHEELS

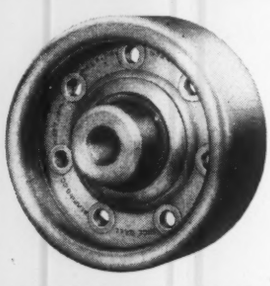
Many-purpose Wheels — Pressed Steel Ball Bearing—for straight, flat tread surface applications.



SERIES 2300 WHEELS

Pressed Steel Ball Bearing flanged tread wheels for application to wood rollers, tubes, etc.





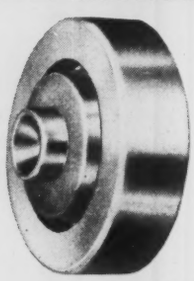
RED DIAMOND CASTERS — SERIES 2400 WHEELS

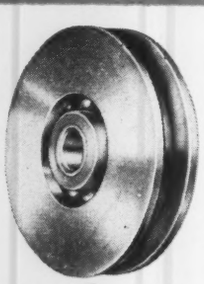
Swivel and Stationary heavy duty Ball Bearing Pressed Steel Caster Assemblies and Caster Type Truck Wheels for floor surface and special purpose applications.

Illustrated and described for your consideration, are some of the "OTHER ANTI-FRICTION PRODUCTS" made by NICE.

Designed and produced by the same skilled technical and production personnel that has made NICE BALL BEARINGS nationally known for 44 years, these supplementary ball bearing products incorporate the same assurance of quality and price advantage that only many years of manufacturing experience can provide.

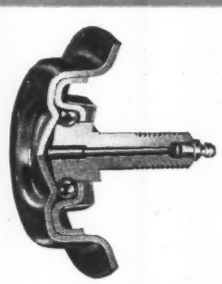
For price and engineering data on the complete line of NICE BALL BEARINGS AND OTHER ANTI-FRICTION PRODUCTS, write for CATALOG NO. 125.





SCREW MACHINE RADIALS

A variety of special Radial Bearings, flat, curved and grooved tread Rollers now available from existing tooling. New items can be designed and produced to match individual specifications.

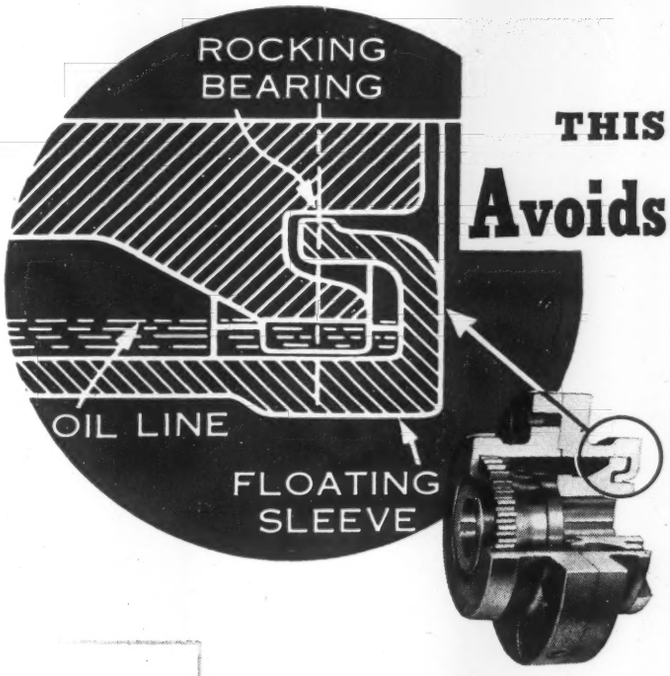


I-BEAM TROLLEY WHEELS

Pressed Steel Ball Bearing — available in many types, with and without flanged tread, for monorail service and special track applications.

NICE

NICE BALL BEARING COMPANY
NICETOWN · PHILADELPHIA · PENNSYLVANIA



THIS METAL-TO-METAL SEAL

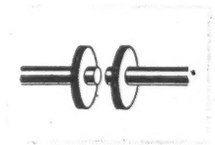
Avoids Coupling Shutdowns!

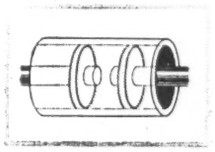
Fast's Couplings Have No Flexible Materials, Give Continuous Service

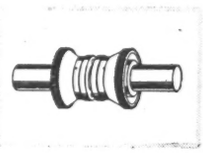
That's right! There are *no* perishable parts in a Fast's Coupling. Nothing to wear. No parts to be replaced. Even the load-carrying oil is guarded by a positive *metal-to-metal* seal. This *exclusive* "rocking bearing" (shown at left) keeps the oil free of moisture, dust, flying grit without use of perishable oil-retaining rings. Result: no shutdowns due to wear from dirt, abrasives or other foreign materials in oil.

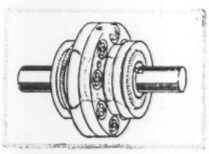
Fast's Couplings Are Simple As A-B-C

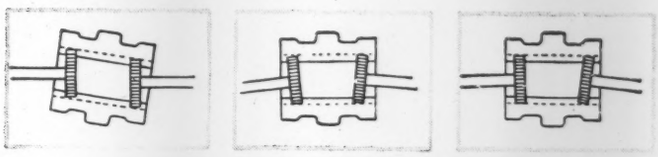
See the simple development of Fast's Couplings. A splined hub on each shaft end, a sleeve with internal splines to mesh. Oil in the sleeve carries the load between the splines.





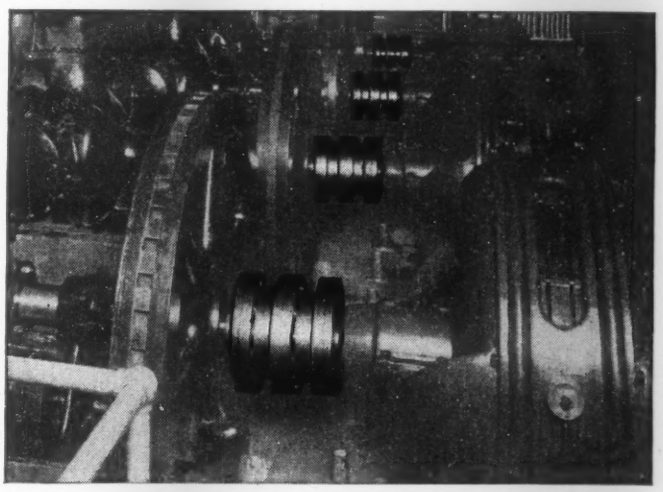






Fast's Couplings Compensate for All Misalignment

The floating sleeve takes a neutral position. All forms of misalignment are compensated for between the lubricated faces of the splines, equally divided between the driving and driven members. The entire assembly revolves as one unit.

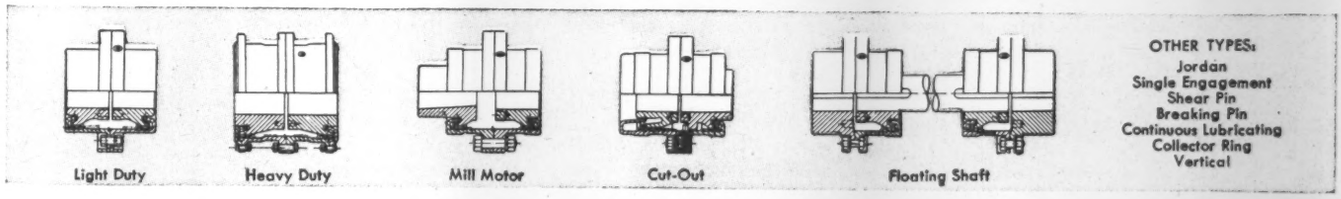


Proof of Dependability are the many "Fast's" installations which have never given a moment's trouble in years of service. This group of Fast's Couplings was installed in 1922 at the Western Maryland Dairy Company's Baltimore plant!

WRITE TODAY for our complete catalog, containing valuable information on Fast's self-aligning Couplings for practically every power transmission condition met in industry. It will help you lengthen the life of your machines, reduce upkeep costs, cut shutdown losses. Koppers Company Inc., Fast's Coupling Dept., 252 Scott Street., Baltimore 3, Maryland.

K
KOPPERS

FAST'S *self-aligning* COUPLINGS



Put them all together, they spell PERFORMANCE

There is no all-purpose BEARING

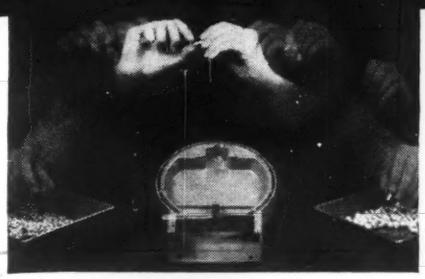
There are too many differences in engine design and operating conditions to make a universal bearing material possible. In our plants we manufacture a wide variety of *silent* sleeve bearings, in hundreds of combinations of design and materials, including plain, flanged and full-round bearings, with steel and bronze backs, lined with tin-base and high-lead babbitts, copper-lead, cadmium-silver, bronze and aluminum alloys. Diecast bearings, bronze bushings, thrust washers and other precision bronze parts are also produced. Quantities may run in millions, thousands or hundreds of pieces. Our research and engineering departments are available for consultation.

FEDERAL-MOGUL CORPORATION
11045 Shoemaker Avenue. • Detroit 13, Michigan

Power goes to work through

FEDERAL-MOGUL

Silent FEDERAL Mogul **SLEEVE BEARINGS**



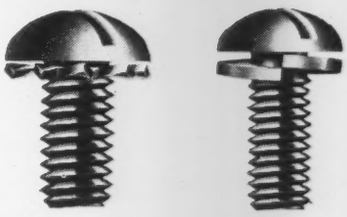
this is

the old way...

When you use SEMS on your assembly line you eliminate the wasteful motions involved in putting the washer on the screw and then carefully positioning the assembled pieces for driving. SEMS bring you both washer and screw pre-assembled as a single unit . . . ready for one easy motion from pan to driving position. There's no "fumbling" when you do it the SEMS way for the washer can't fall off!

Send for samples today and conduct your own demonstration. See for yourself how SEMS reduce costs by simplifying and speeding production and at the same time provide quality control because the worker can't "forget" the washer.

this is the SEMS way



use SEMS the MODERN fastener unit

SEMS are Pre-Assembled Washer and Screw Units in which the Washer is held on the Screw by the Rolled Thread and is free to rotate.

SEMS ARE AVAILABLE FROM THE FOLLOWING MANUFACTURERS

Continental Screw Co.
New Bedford, Mass.

Corbin Screw Division
The American Hardware Corp.
New Britain, Conn.

Eaton Manufacturing Co.
Reliance Division
Massillon, Ohio

The Lamson & Sessions Co.
Cleveland, Ohio

National Lock Co.
Rockford, Illinois

The National Screw & Mfg. Co.
Cleveland, Ohio

New England Screw Co.
Keene, N. H.

Pheoll Manufacturing Co.
Chicago, Illinois

Russell, Burdsall & Ward
Bolt & Nut Co.
Port Chester, N. Y.

Scovill Manufacturing Co.
Waterville Division
Waterville, Conn.

Shakeproof Inc.
Division of Illinois Tool Works
Chicago, Illinois

Steel Co. of Canada, Ltd.
Hamilton, Ont., Canada

Stronghold
Screw Products Inc.
Chicago, Ill.

American Screw Co.
Providence, R. I.

Central Screw Co.
Chicago, Ill.

Chandler Products Corp.
Cleveland, Ohio

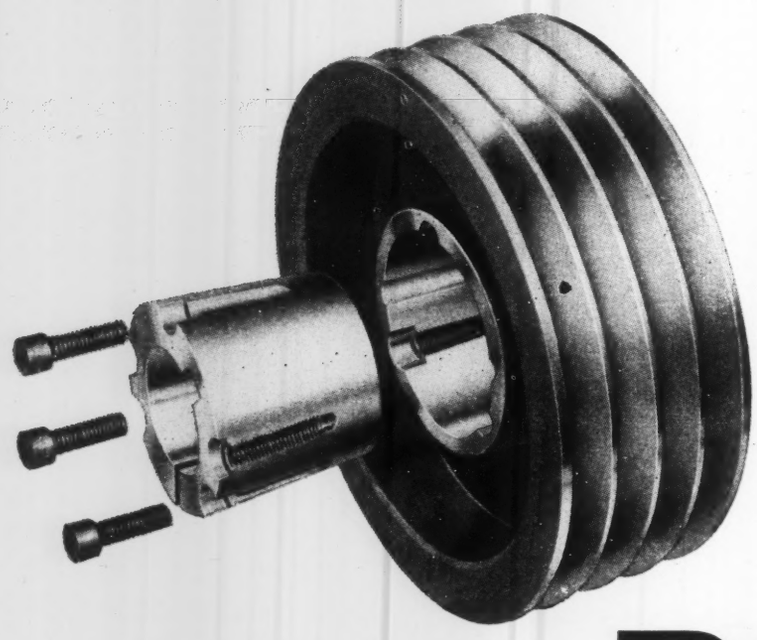
Complete unit.
Slip it on, line it up
and tighten while
sighting.

The simplest,
surest mechanism ever
devised for holding
wheels to shafts.

TAPER-LOCK BRAND

A New Cost-Saving Taper Bore Sheave

Holds fast to
the shaft with firmness
equivalent to a
shrunk-on fit.



Disengages
with less effort than
any other sheave.
Easy on. Easy off.

Complete
range of sizes in
Dual Duty (A and B);
B, C and D grooves.

DODGE

of Mishawaka, Ind.

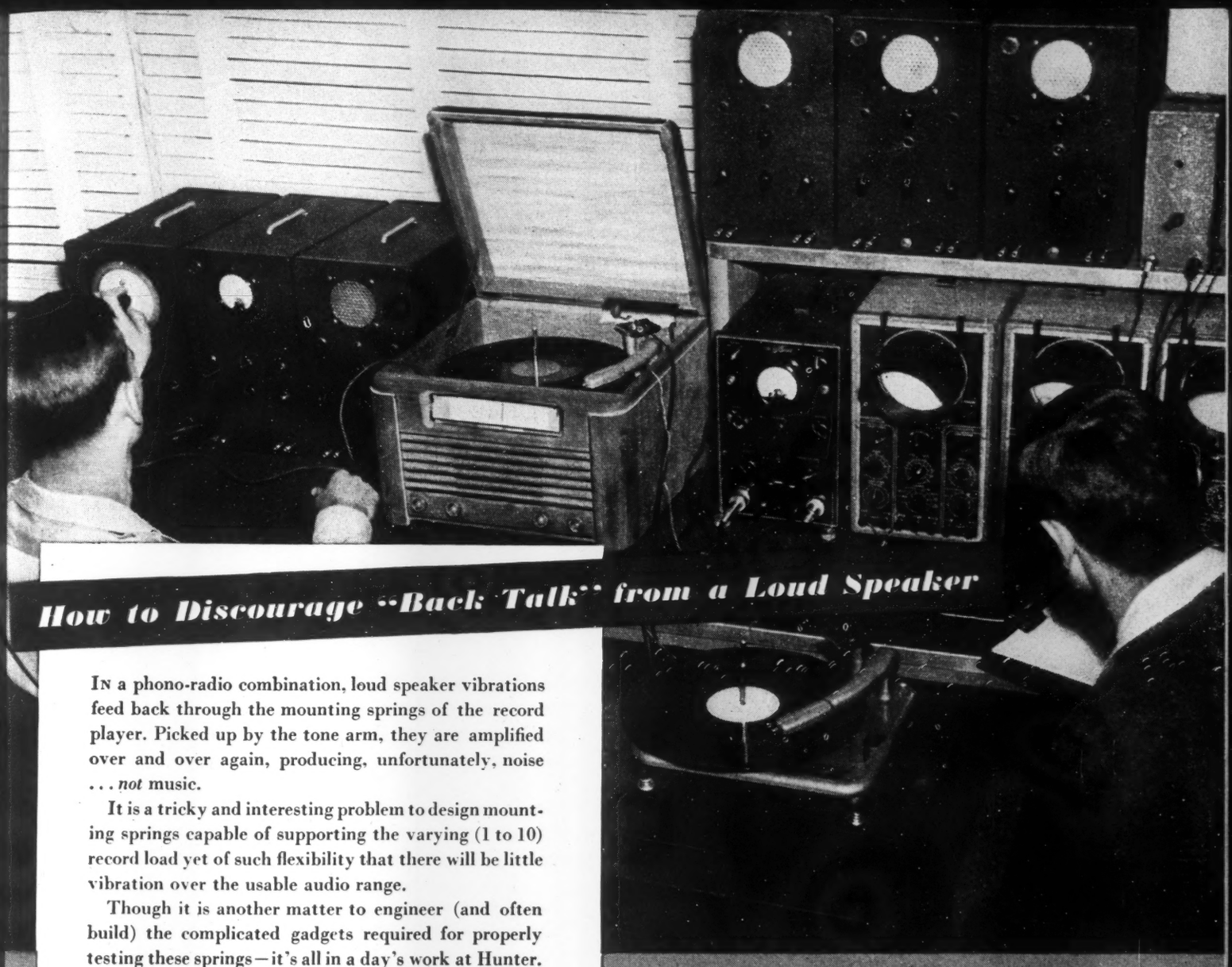
For details about cost-saving developments in power transmission equipment, call the Transmissioneer—your local Dodge distributor. He's factory-trained, qualified to suggest ways to improve machine performance and increase production. Look for his name under "Power Transmission Equipment" in your classified telephone directory.

DODGE MANUFACTURING CORP., MISHAWAKA, INDIANA

Copyright, 1947, Dodge Mfg. Corp.

NAME PLATES

FOR YOUR NAME PLATE REQUIREMENTS, WRITE OUR SUBSIDIARY,
ETCHING COMPANY OF AMERICA, 1520 MONTANA STREET, CHICAGO 14, ILLINOIS

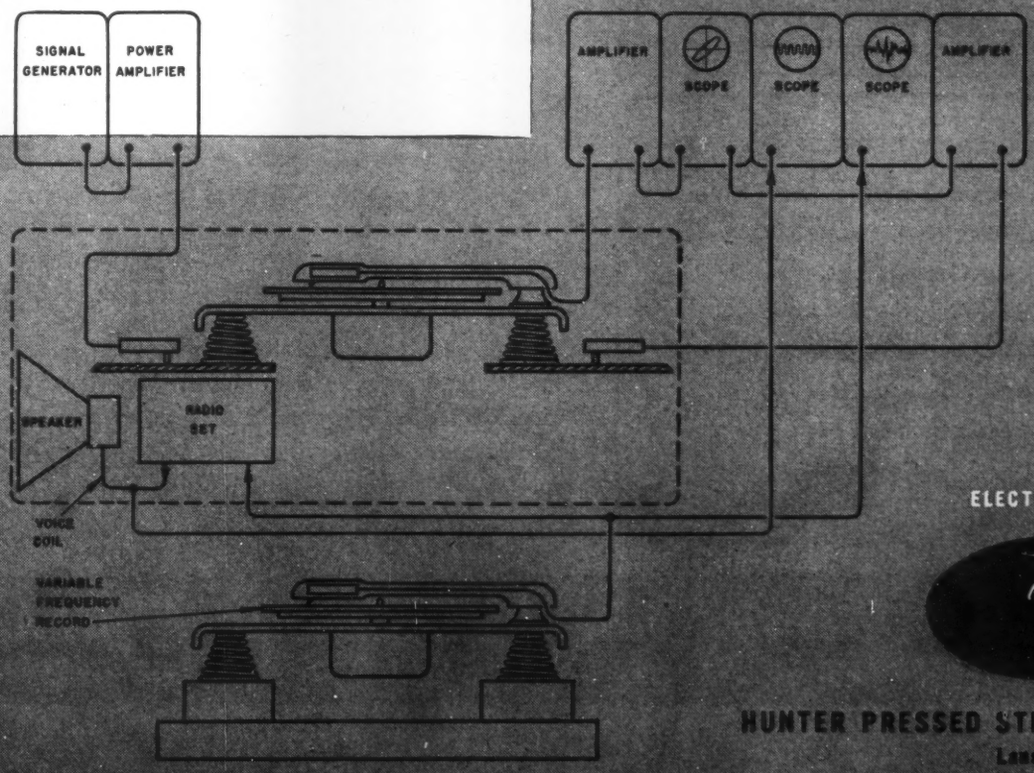


How to Discourage "Back Talk" from a Loud Speaker

IN a phono-radio combination, loud speaker vibrations feed back through the mounting springs of the record player. Picked up by the tone arm, they are amplified over and over again, producing, unfortunately, noise . . . *not* music.

It is a tricky and interesting problem to design mounting springs capable of supporting the varying (1 to 10) record load yet of such flexibility that there will be little vibration over the usable audio range.

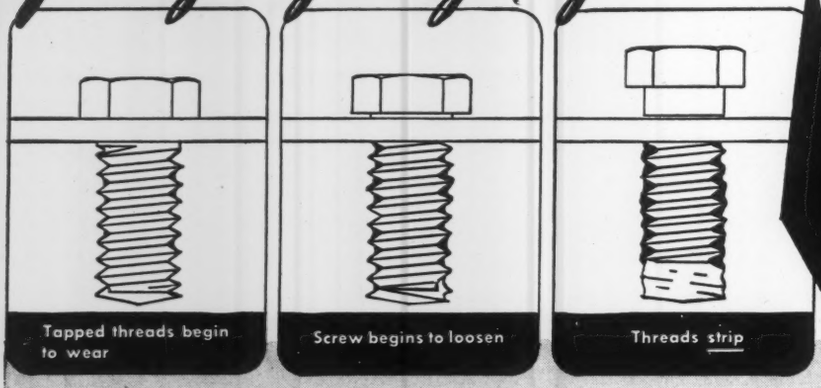
Though it is another matter to engineer (and often build) the complicated gadgets required for properly testing these springs—it's all in a day's work at Hunter. And here you see mounting springs on trial in the Hunter inspection laboratory.



SPRINGS
METAL STAMPINGS
WIRE FORMS
MECHANICAL AND
ELECTRICAL ASSEMBLIES

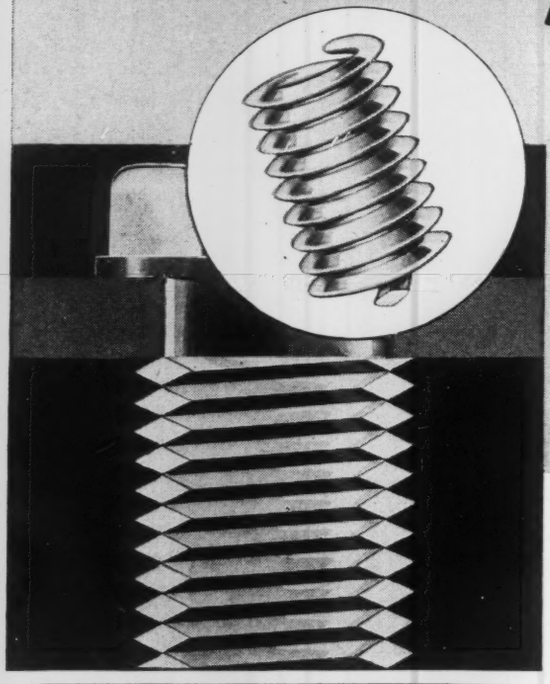
HUNTER PRESSED STEEL COMPANY
Lansdale, Pennsylvania

Going! Going!! Gone!!!



This shouldn't happen to YOUR product!

Protect Tapped Threads with HELI-COIL* Inserts



UNPROTECTED tapped threads are subject to abrasion, stripping, seizing and galling. This means inferior product performance, more part replacements—customer dissatisfaction.

Metal and plastics product manufacturers—whose prime objective has always been utmost dependability—find the simple solution to such threaded fastening problems in precision-made *Heli-Coil* inserts. Made of stainless steel or phosphor bronze wire, *Heli-Coil* inserts line tapped threads of the American National System—provide a hard, tough bearing surface which prevents wear.

Today, *Heli-Coils* keep production up, costs down, both as original parts in manufacture, and for repair of damaged threads. For complete details write for descriptive literature.

ENGINEERING REPRESENTATIVES

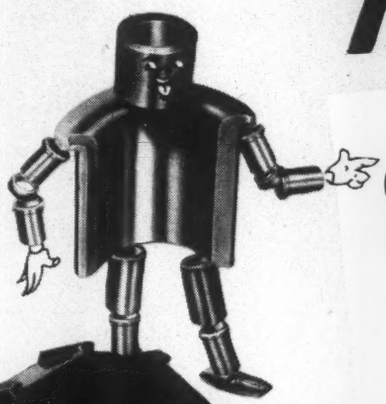
G. C. Brown & A. W. Reader, Royal Oak, Michigan
Donald McClain, Hartford, Connecticut
D. Lynn Churchwell, Lone Fountain, Virginia
W. E. Brieco, Kansas City, Missouri
J. S. Wise, Los Angeles, California
M. H. Miller, Salt Lake City, Utah
R. H. Wixson, Dallas, Texas
Carl H. Henry, Atlanta, Georgia

*Reg. U. S. Pat. Off.

HELI COIL

AIRCRAFT SCREW PRODUCTS COMPANY, INC.
47-23 35th STREET • LONG ISLAND CITY, 1, N.Y.

Bearing Problems?



End for Sink Roll, 14" dia.

GATKE Moulded Fabric Thrust Rings, 5½" dia.

SEE GATKE

GATKE Bearings are effecting wonderful economies on all sorts of troublesome applications where short life, production delays and costly up-keep are accepted as unavoidable with conventional bearings.

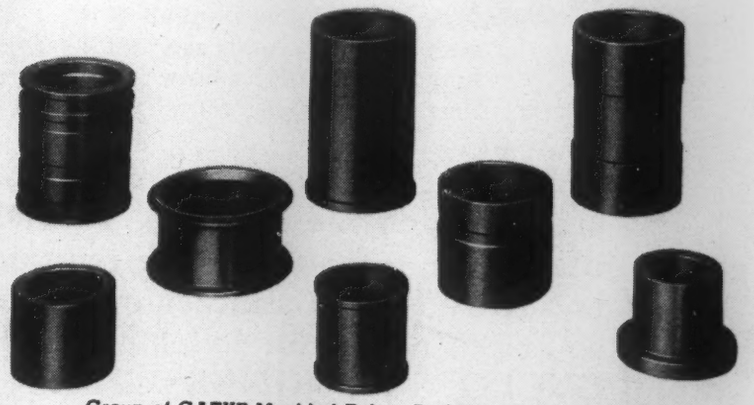
The extraordinary performance results from qualities not obtainable in metal bearings — performance qualities made possible by GATKE Processes of moulding select fabric materials to finished dimensions under heat and tremendous pressures.

Tremendous impact strength with resilience to absorb shock and dampen vibration, extraordinary grease-retaining qualities, freedom from scoring and corrosion are but a few of the many important advantages.

Whatever the service—however difficult or unusual—send data for the GATKE Recommendation or write for literature.

GATKE CORPORATION
252 N. LaSalle St., Chicago 1, Ill.

GATKE Bearings used on Rubber Mills. Reports show 10 years of perfect operation where conventional bearings had been a constant source of trouble and expense.



Group of GATKE Moulded Fabric Bushings with flanges and other external shapes. Sizes range from 2½" to 5" dia.

Gatke MOULDED FABRIC BEARINGS

THE CONVAIR B-36, THE WORLD'S LARGEST BOMBER

is powered by six Pratt and Whitney, 28-cylinder, pusher-type engines developing a total of 18,000 horsepower, enough to power 200 average passenger cars. The 163-foot long, 47-foot high plane has a wing span of 230 feet and a maximum speed of over 300 mph.

The impact of 278,000 pounds landing on a runway must pass through the R B C CYCLOPS-TYPE AIRCRAFT BEARING supporting the trunnions of the massive landing gear. This is another example of R B C engineering co-operating in the development of another first. R B C CYCLOPS BEARINGS will help to increase the efficiency of the machines YOU design. Write us—R B C Engineers will be glad to assist you.

ROLLER BEARING CO. OF AMERICA
TRENTON, NEW JERSEY

Thin as .001" and it's ALLOY strip

CMP LIGHT GAUGE ALLOY STRIP

COLD FACTS ON
CMP ALLOY STRIP
ADVANTAGES

- Depending on the grade, here are some of the advantages over carbon steels —
- Weight can be reduced without loss of strength.
- By maintaining equal weight, strength can be greatly increased.
- High tensile values are obtainable in certain alloy Thinsteel grades.
- Unusual fatigue resistance demonstrable by flexing tests.
- Greater resistance to atmospheric corrosion.

GIVES MAXIMUM PRODUCTION PER TON

Cold rolled alloy strip in gauges thin as .001? Yes, sir! And made available for the first time from any source by CMP. You gain many fabricating advantages through the usual qualities identified with CMP Precision Techniques, too . . . the uniformity and accuracy of all CMP Thinsteel products. Why not make inquiry now? — it may be your answer to better product and production.

THINSTEEL

THE COLD METAL PRODUCTS CO.
YOUNGSTOWN 1, OHIO

Sales Offices
NEW YORK • CHICAGO • DETROIT • ST. LOUIS
BUFFALO • DAYTON • LOS ANGELES

Anti-Corrosive STAINLESS STEEL fastenings

These Nuts Are DIFFERENT!

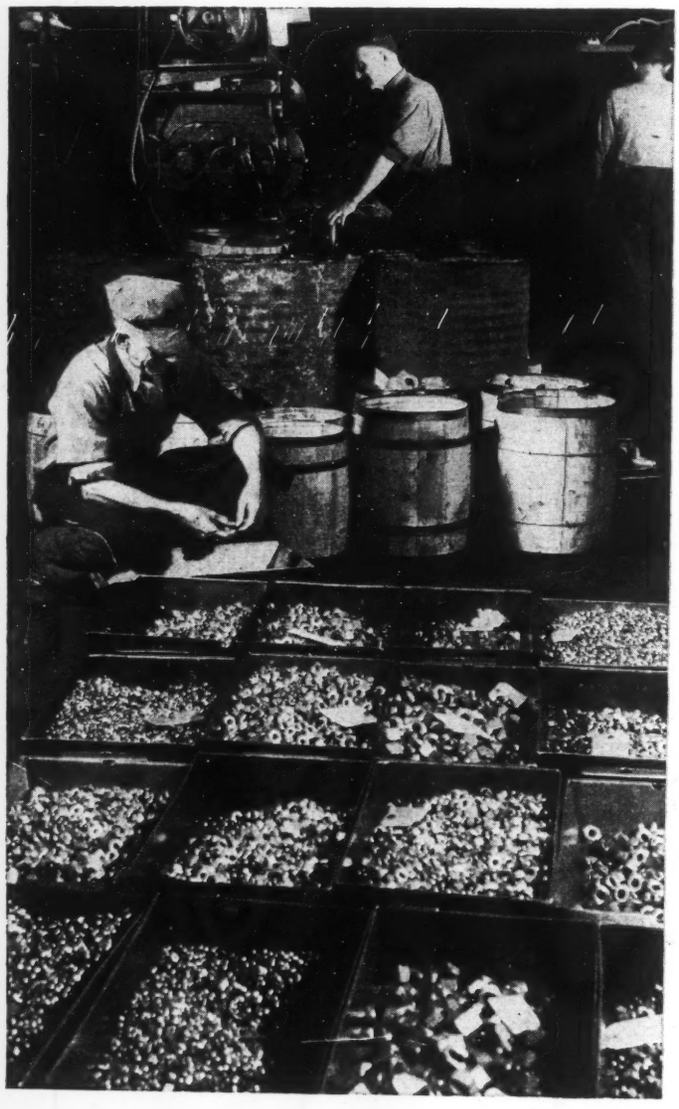
They're Stainless Steel Nuts, fresh from our production line—Stainless Steel Nuts, corrosion-resistant, longer-lasting, ideal for any use where corrosion is present.

What's more, they're only one of the many items we make and stock—Stainless Steel Fastenings of all kinds, in all sizes and analyses.

If you're looking for quick delivery on standard items, our stock room can fill your order at once. If you need something special, we have the raw materials to fill your order promptly—in any analysis of Stainless Steel, to meet any specifications.

Nuts, bolts, wood and machine screws, rivets, cotter pins, nails, welded and seamless pipe, pipe fittings—over 100 items, over 7,000 sizes—all STAINLESS STEEL!

Write for our catalog and stocklist. Address Anti-Corrosive Metal Products Co., Inc., 57 River Road, Castleton-on-Hudson, N. Y.



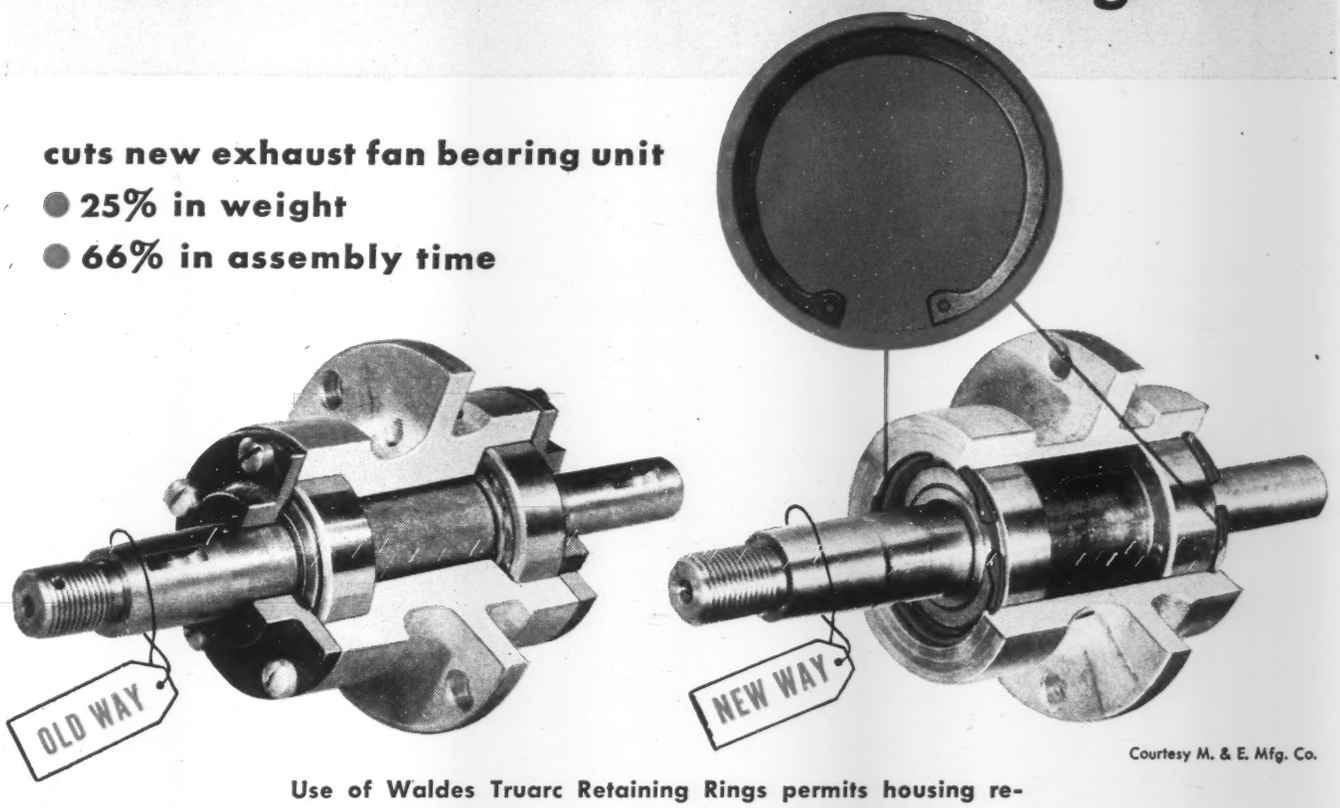
Anti-Corrosive Metal Products Co. Inc.

CASTLETON-ON-HUDSON NEW YORK

TRUARC trims 13 minutes machining to 6

cuts new exhaust fan bearing unit

- **25% in weight**
- **66% in assembly time**



Courtesy M. & E. Mfg. Co.

Use of Waldes Truarc Retaining Rings permits housing redesign—eliminates heavy cast bearing caps and screws requiring drilling and tapping; lowers labor and material cost.

"TRUARC PAYS DIVIDENDS IN SAVINGS!" declares M. & E. Manufacturing Company, of Indianapolis, makers of exhaust fans for industry. "Improvements in design made possible by Waldes Truarc Retaining Rings provide a quieter, freer-running assembly, assure longer life to the entire unit, eliminate the hazards of uneven unnecessary pressure on the bearing and minimize future service requirements. In our experience Truarc has definitely proved itself the better method for doing an important job."

Truarc does a better job on axles and shafts for retaining and positioning wheels, pulleys, cams and gears. In widely varied applications, designers find its never-failing grip, its patented design that assures constant circularity, make Truarc the better way to hold machine parts together. Production and maintenance men in many industries see how Truarc rings cut costs sharply, maintain accurate, unvarying relationship of parts. Send us your drawings; Waldes Truarc engineers will be glad to show how Truarc can help you.

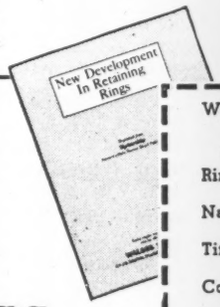
WALDES

TRUARC

U. S. PATENT RE. 18,144

RETAINING RINGS

WALDES KOHINOOR, INC., LONG ISLAND CITY 1, NEW YORK



● ***Send for new Truarc booklet, "New Development In Retaining Rings"***

Waldes Kohinoor, Inc., 47-10 Austel Place 21-K
Long Island City 1, N. Y.

Please send booklet, "New Development In Retaining Rings" to:

Name_____

Title_____

Company_____

Business Address_____

City_____ Zone____ State_____

REDUCING DIET FOR RAILROADS

...and for everybody

The important advantages of a steel casting for a railroad guard rail end filler are these:

1. Less weight to buy. The cast steel part weighs 18 pounds, against a weight of 46 pounds for the previous design and material—weight saving, 60%.
2. 60% less weight to transport. It costs just as much for a railroad to carry its own materials as it does to carry pay load.
3. 60% less weight to lift and handle—that's help for storage and track crews. The cast steel part is strong, rigid and resists wear and breakage—it does everything it's supposed to do better than its heavier predecessor.

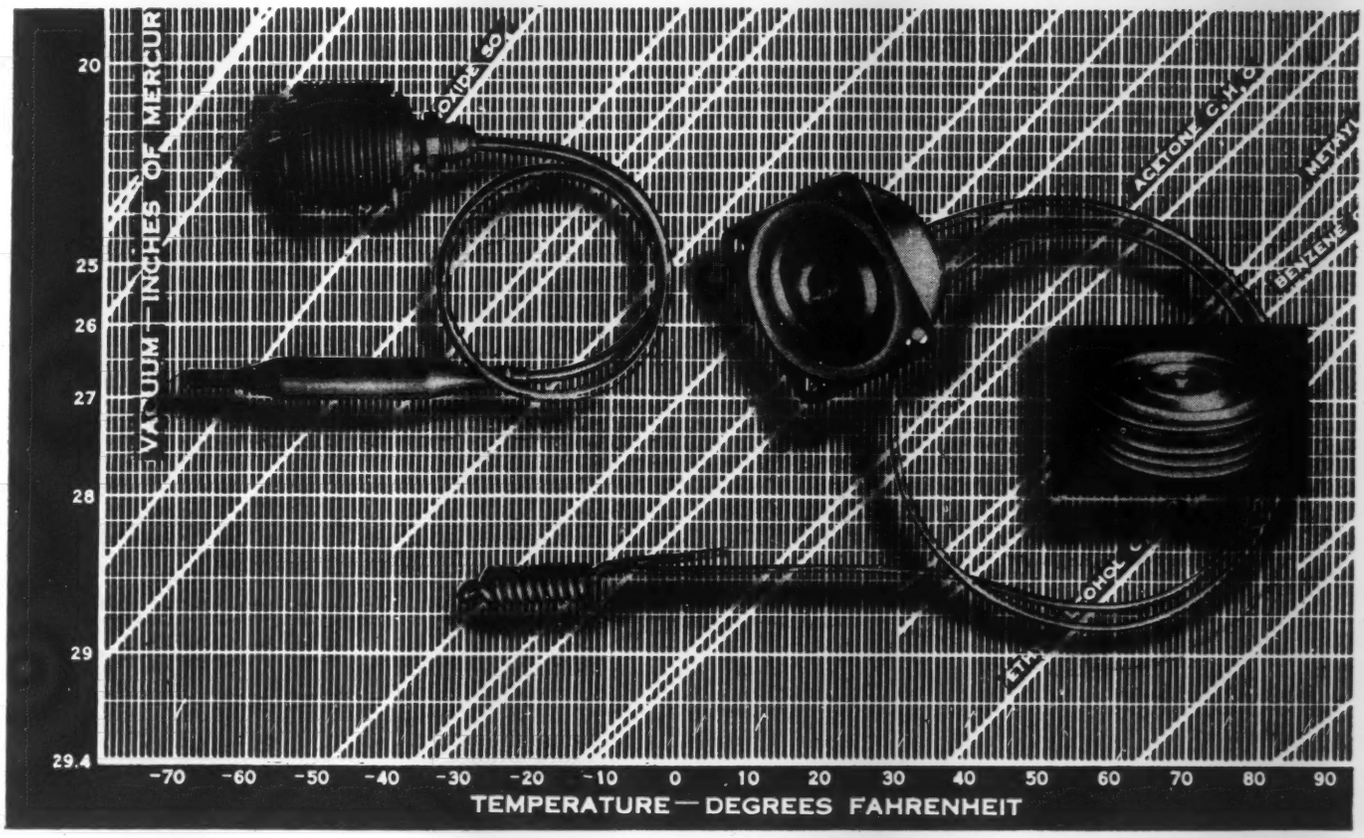
There you have the reasons why railroads use more steel castings than any other industry. Just sound economy—just good intelligent management.

Are *your* products suffering from useless overweight? Are you paying a penalty for not being as modern as steel castings?

The first step in making an improved product, or in cost cutting, is to plan it that way—a steel castings engineer can help you. Steel Founders' Society, 920 Midland Building, Cleveland 15, Ohio.

MODERNIZE AND IMPROVE YOUR PRODUCT WITH

STEEL CASTINGS



ESSENTIAL FEATURES IN A BELLOWS ASSEMBLY

...and how Clifford engineering can help you get them

For the remote control of temperatures, a smoothly functioning bellows assembly engineered for the individual application is absolutely essential. The selection, application and handling of the thermosensitive filling medium are particularly critical, requiring an intimate knowledge of the medium's physical properties and chemical stability under all operating conditions.

HYDRON BELLOWS AND BELLOWS ASSEMBLIES

In addition to supplying HYDRON (Hydraulically-formed) bellows for many industrial purposes, Clifford specializes in producing bellows assemblies to individual specifications. Like the refrigerator assemblies illustrated, these are complete thermal units. Each unit is filled, sealed and tested, ready for installation.

COMPLETE HYDRON ASSEMBLIES PREFERRED

An increasing number of manufacturers are using these complete assemblies — preferring the undivided responsibility of an organization that has the engineering experience and equipment vital to this extremely technical work . . . If your own production involves remote or direct control of temperatures or pressures, Clifford engineering may save *you* time, trouble and expense. Send us prints and specifications and we will be glad to quote you.

CLIFFORD MANUFACTURING COMPANY, 566 E. First St., Boston 27, Mass. *Offices in Detroit, Chicago, Los Angeles.*

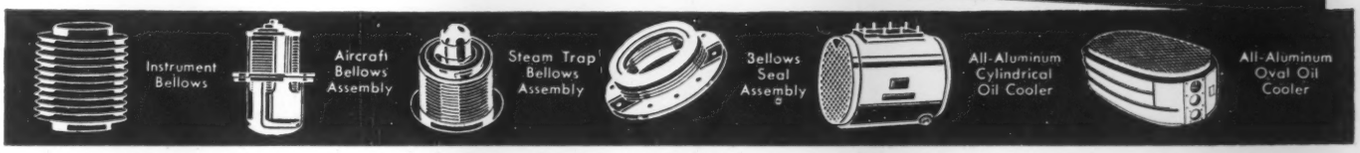
HYDRON Metal Bellows

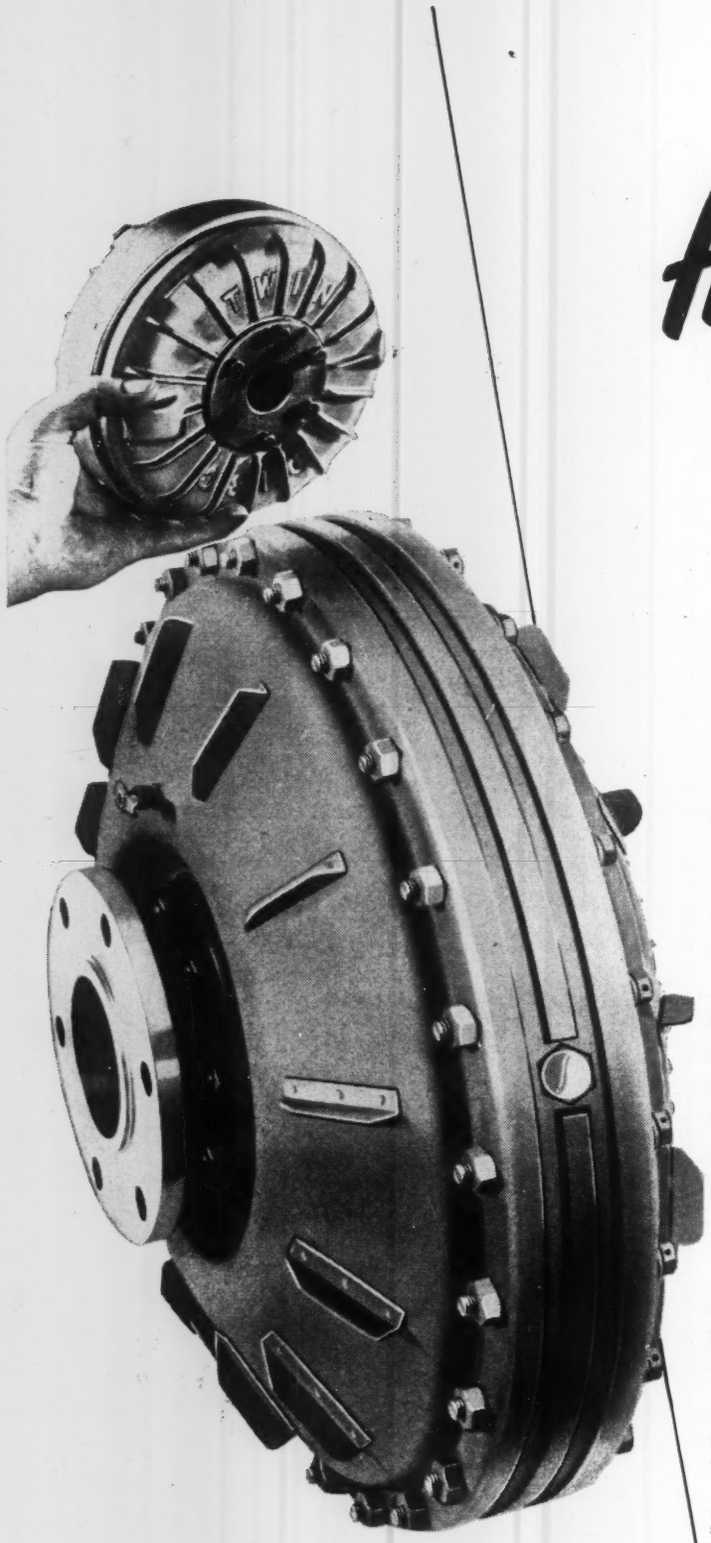
CLIFFORD

First with the Facts on Hydraulically-Formed Bellows

HYDRON

Feather-Weight . . . The First All-Aluminum Aircraft Oil Coolers . . . Made of Hydron Tubing Brazed by our Patented Method.





Hydraulic Couplings

for every application

You can obtain a smooth, flexible flow of power from internal combustion engines or electric motors . . . from 1 to 300 hp . . . by transmitting power to the driven parts through a Twin Disc Hydraulic Coupling.

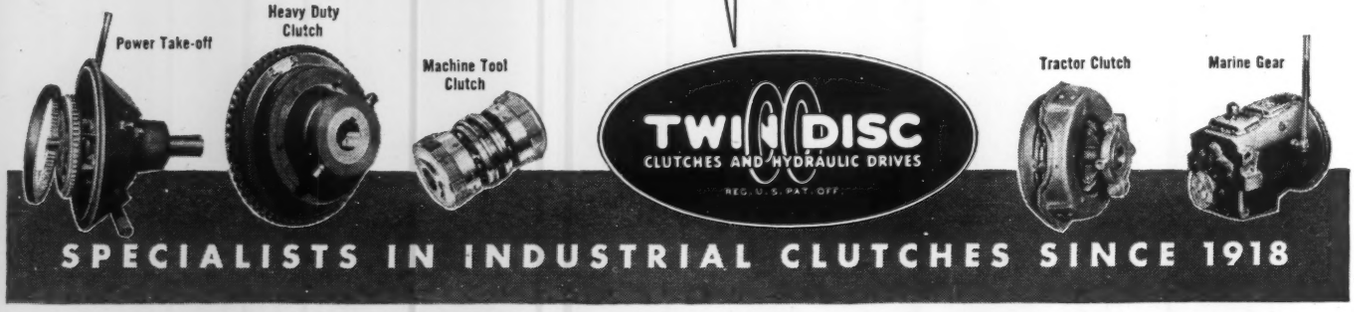
Improved utilization of power in the lower horsepower range became possible when new Small Hydraulic Couplings were added to the Twin Disc line of Hydraulic Couplings . . . Couplings which long ago proved themselves in a wide variety of heavy-duty applications.

The new Small Coupling incorporates all the features of superior design inherent in the line, and offers users the same advantages . . . smoother operation . . . full torque delivery at all output speeds . . . prevention of engine or motor stalling . . . easy starting of heavy loads. TWIN DISC CLUTCH COMPANY, Racine, Wisconsin (Hydraulic Division, Rockford, Illinois).

Bulletin No. PR 10 explains how the advantages of Small Hydraulic Couplings can be utilized with your 1 to 25 hp units. Write for your copy to the Twin Disc Clutch Company, Racine, Wisconsin.

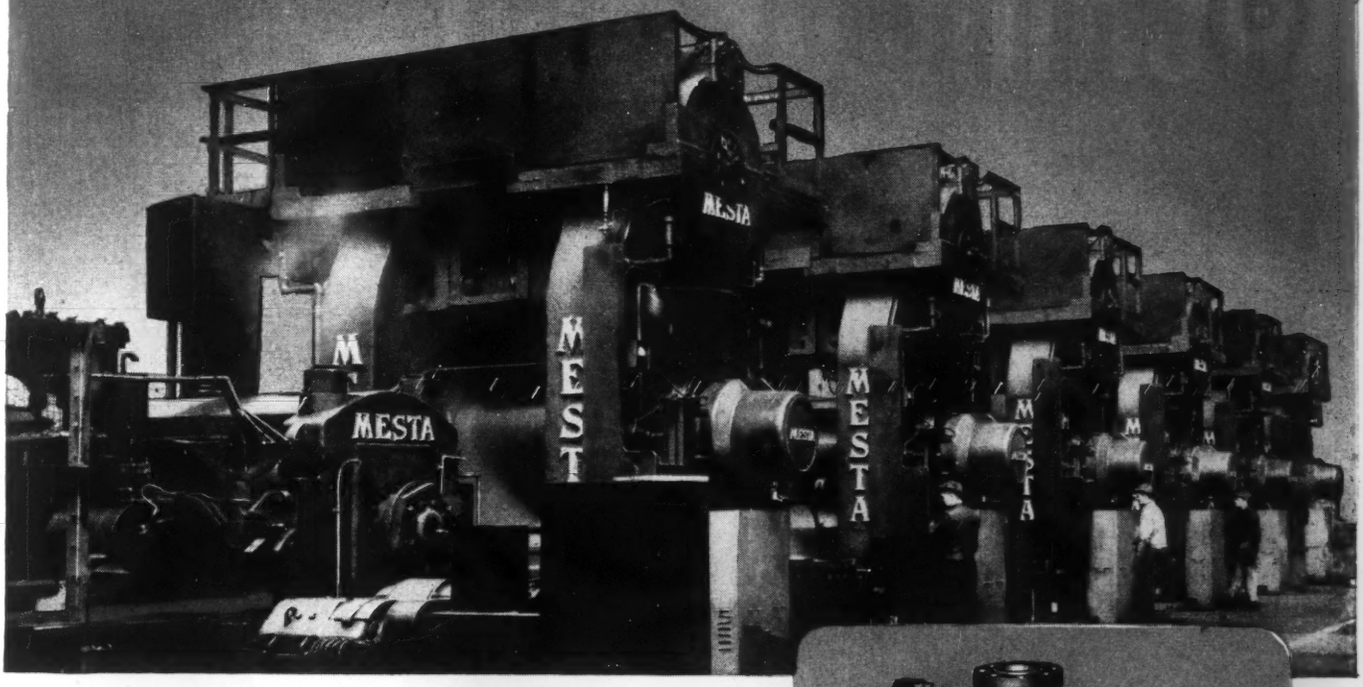
Top: The complete new line of Twin Disc Small Hydraulic Couplings is being made available in sizes from 7.4″ to 12.2″, capacities of 1 to 25 hp at 1800 rpm.

Left: The larger Twin Disc Hydraulic Coupling is furnished in sizes from 14.5″ to 21″.



SPECIALISTS IN INDUSTRIAL CLUTCHES SINCE 1918

Leading Steel Companies Depend on HUNT Quick-As-Wink Control Valves

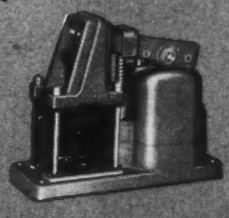


This 56" Four-High Continuous Hot Strip Mill, equipped with Quick-As-Wink valves, was built by the Mesta Machine Co. of Pittsburgh.

SAFE, positive control is important in heavy steel mill equipment. That's why Mesta engineers used Hunt Quick-As-Wink valves in the hot strip mill machinery built for a large Canadian steel company. The Hunt descaling valve, for example, regulates the flow of the high pressure descaling water, and because the opening and closing speeds can be adjusted, the valve eliminates water hammer. The solenoid air valves give dependable, trouble-free control of the descaling valves.

C. B. Hunt & Son, Inc., manufactures single and double solenoid valves in a variety of sizes. Air, hand, foot, and diaphragm operated valves are also available. 2-way, 3-way, and 4-way hydraulic valves are made in pressure ranges up to 5,000 p.s.i.

The pilot-operated, 2-way descaling valve is made in sizes 2" to 6" inclusive and for pressures up to 3500 p.s.i.



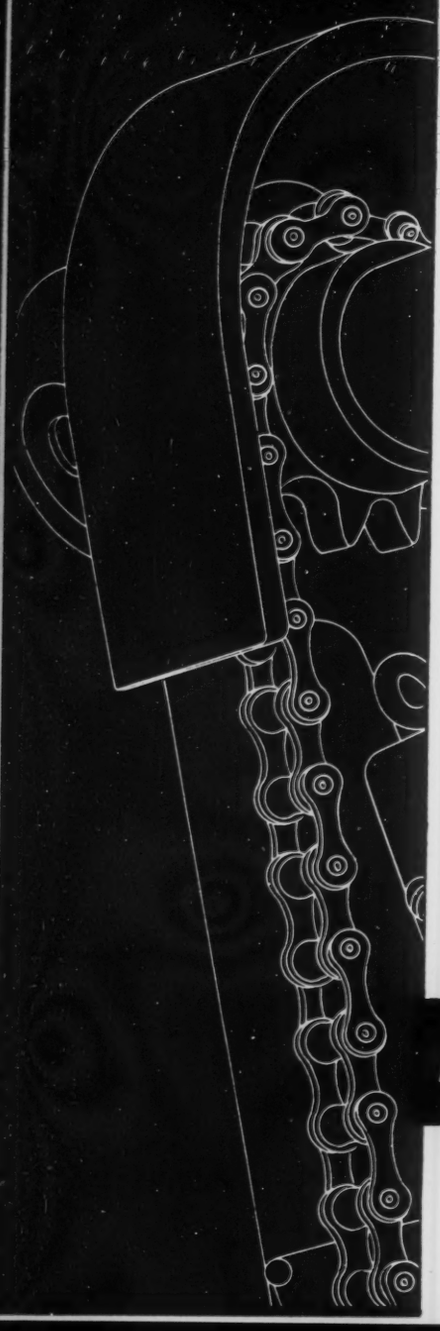
The solenoid operated air valve adapts itself to automatic operation by means of time cycle controls or other automatic control devices. Enclosing protective covers – easily and quickly removed – are available for solenoid valves.

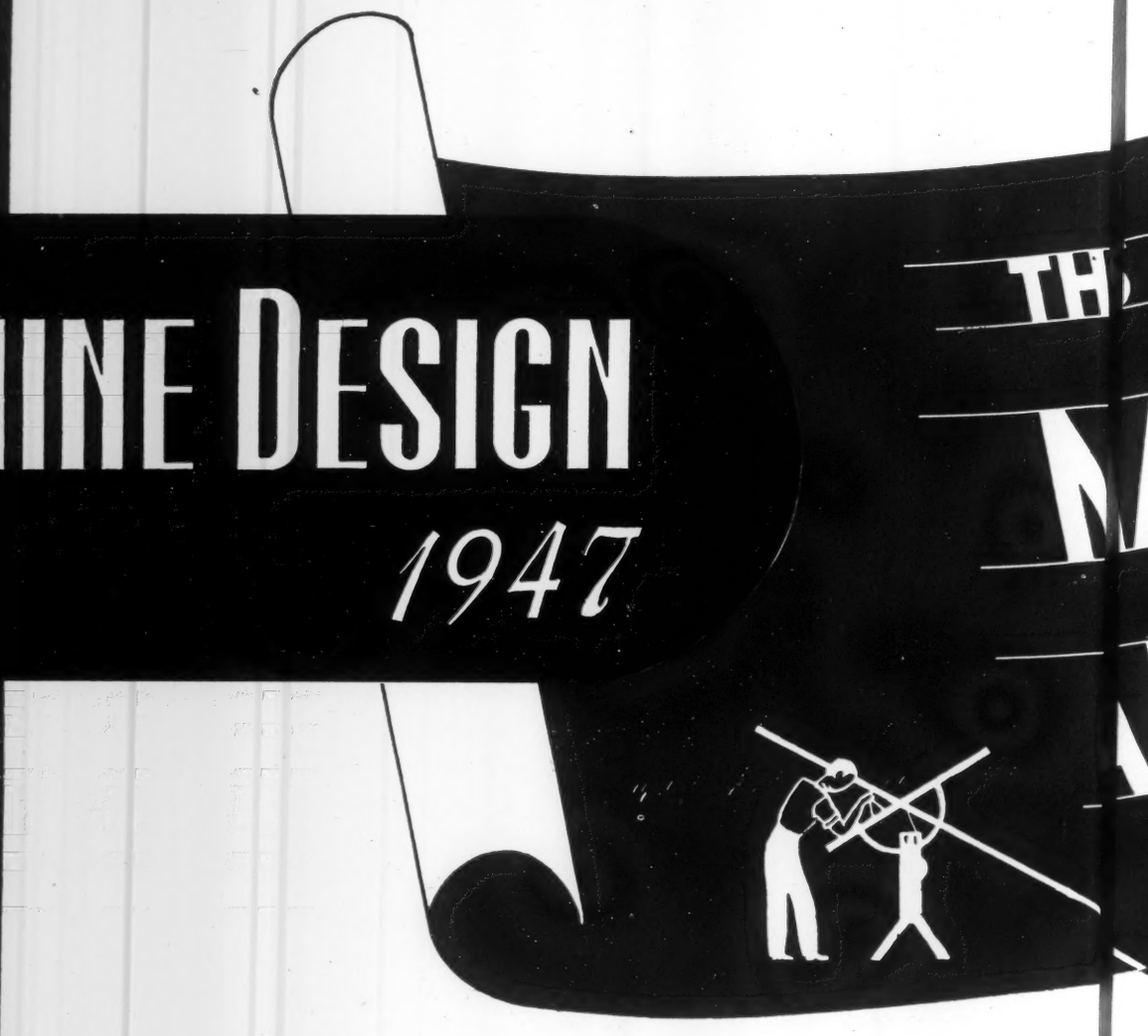
Quick-As-Wink
HUNT CONTROL VALVES

C. B. HUNT & SON, INC., SALEM, OHIO

MACHINE DESIGN

April *1947*



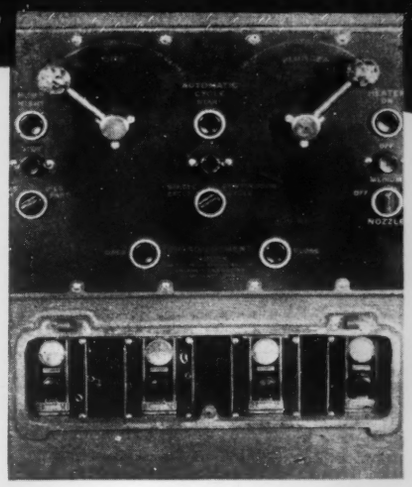


EDITORIAL FEATURES

Selection of Motors—Automatic Presetting of Controls—Unusual Gear Drives—Interlocking Control Systems—Torsional Vibration Dampers for Power Drive—Automatic Power Controls—Coupling and Clutch Applications—Electronic Controls—Electromagnetic Drives—Remote Controls — Solenoid-Operated Mechanisms — Hydraulic Drives and Controls—Pneumatic Power and Its Control—Drive and Control Features of Specific Machines.

MACHINE DESIGN IS NOW READ BY M

H ISSUE DEVOTED ENTIRELY TO
MACHINE DRIVES
AND CONTROLS



THE April issue of MACHINE DESIGN, bringing Design Engineers as it has for the past ten years a comprehensive roundup of all that's new in machine drives and controls, has become a standard reference work on these subjects.

MACHINE DESIGN editors, in collaboration with outstanding industrial design authorities will present in the April issue feature articles on developments over the past year in power transmission and control equipment used on all types of machines. These two subjects will be treated objectively so that every reader may have a clear picture of the latest advances.

This eleventh edition of MACHINE DESIGN on drives and controls will furnish you with the information necessary to specify the proper power and control units for your company's products. This April issue will prove of lasting value throughout the year as a reference and convenient source of information.

RE THAN 50,000 DESIGN ENGINEERS EVERY MONTH

Plan for a DROP in maintenance costs

Maintenance is an important factor, and must be given ample consideration in designing machine drives.

To minimize maintenance costs, choose chains—time-tested Whitney Roller Chains. In most services, the maintenance problem is nothing that just a little oil won't solve.

Parts are durably made—durably assembled—can be relied upon to deliver full-rated machine capacity and to withstand shocks and overloads in hard and continuous service . . . It pays to standardize on Whitney.

THE WHITNEY CHAIN & MFG. CO., HARTFORD 2, CONNECTICUT

Complicated Shapes

ARE NOW EASILY MADE WITH **FORMICA!**

NEWLY developed post-forming techniques have made it possible to produce Formica economically in many new and useful shapes for all sorts of uses.

The method is simple. Sheets of a special grade of material are heated and placed in a press with wooden dies and stamped to the required shape. That shape is retained for the life of the material.

This has made the adaption of the material possible to many new uses. Perhaps it would serve better some purpose that you are now taking care of with metal.

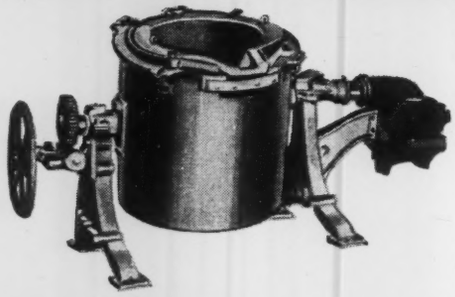
FORMICA
TRADE MARK REG. U.S. PAT. OFF.

THE FORMICA INSULATION CO., 4648 SPRING GROVE AVE., CINCINNATI 32, OHIO

INDUSTRIAL FURNACES

OVENS • MELTING FURNACES

INDUSTRIAL HEATING FURNACES



MELTING FURNACES—for melting aluminum and magnesium. Electric, gas or oil fired.

Designs by Campbell-Hausfeld, Fisher, Stroman and others.

OVENS—for baking lacquer, enamel, synthetic resin, japanning, for low temperature metal heat treating, for drying and curing chemicals, rubber, paper, lithographing, plastics, ceramics, etc.

Made by Despatch, Gehnrich and Gehnrich, Maehler, Young Bros., W. S. Rockwell, Surface Combustion, Porbeck, General Electric, Stewart and others.

INDUSTRIAL HEATING FURNACES—

Continuous and Batch Type
Rotary Hearth
Tunnel Type
Box Type
Atmospheric Control Type

Made by these well-known manufacturers: American Gas Furnace Company, Dempsey, Despatch Furnace Company, Electric Furnace Company, Gas Machinery Company, Industrial Heating Equipment Company, Ingersoll-Rand, Lindberg, Whiting Corporation, General Electric, and many others.

These furnaces are products of the best American manufacturers. They have recently been declared surplus and are now ready to take their places on industry's production lines, to be counted again among the country's industrial assets. Every furnace is priced far lower than you have ever thought possible. Now—this very day—is the time to learn the details concerning the furnaces offered. Write, phone or visit your nearest WAA Regional Office.

Principal inventories are located at Boston, New York, Philadelphia, Richmond, Cleveland, Detroit, Chicago, St. Louis, Minneapolis, Cincinnati. However, any WAA Regional Office is prepared to give complete information and arrange for purchase. All furnaces offered subject to prior sale.

All furnaces are sold under existing priority regulations. VETERANS OF WORLD WAR II are invited to be certified at the War Assets Administration Certifying Office serving their area, and then to purchase the materials offered herein.

Exporters: Your business is solicited. If sales are conducted at various levels, you will be considered as a wholesaler. Any inquiries regarding export control should be referred to Office of International Trade, Department of Commerce, Washington, D. C.

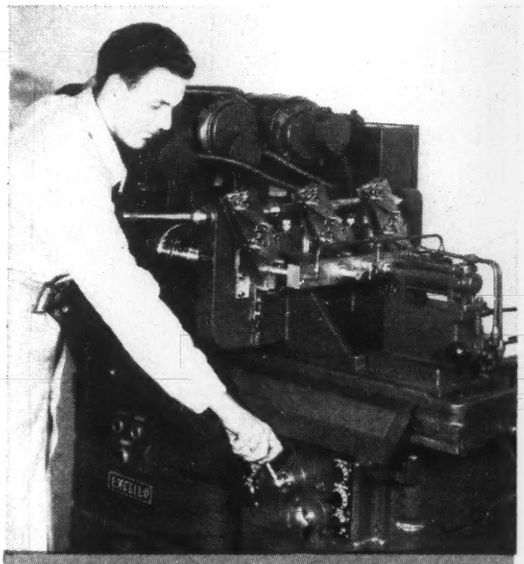
WAR ASSETS ADMINISTRATION

GOVERNMENT OWNED SURPLUS

Offices located at: Atlanta • Birmingham • Boston • Charlotte • Chicago • Cincinnati • Cleveland • Dallas • Denver • Detroit • Fort Worth • Helena • Houston • Jacksonville • Kansas City, Mo. • Little Rock • Los Angeles • Louisville • Minneapolis • Nashville • New Orleans • New York • Omaha • Philadelphia • Portland, Ore. • Richmond • Salt Lake City • St. Louis • San Antonio • San Francisco • Seattle • Spokane • Tulsa

838-2

Are material and labor costs pinning you down?



● This Style 2112-A Ex-Cell-O Precision Boring Machine (above) is equipped with loading chutes and a hydraulically operated loading and ejecting device. The bushings shown in the loaded chutes are both semi-finished and finish bored at the rate of 666 pieces per hour net.

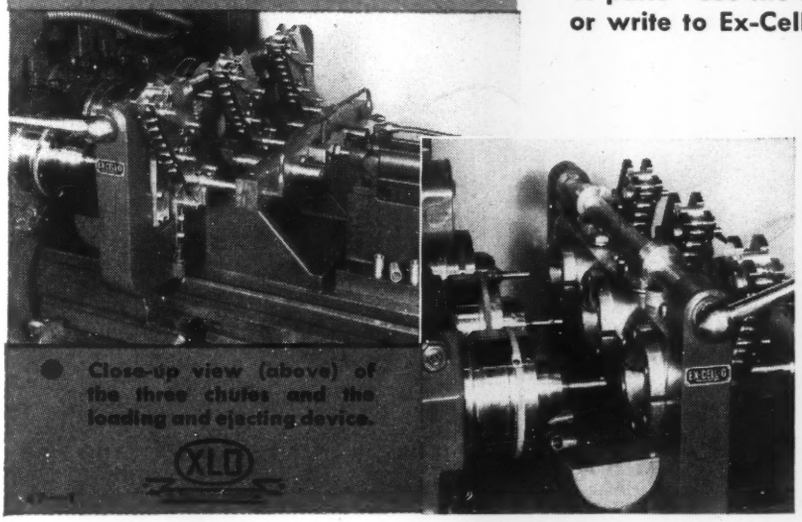
YOU CAN OFFSET THEM WITH EX-CELL-O PRECISION BORING MACHINES . . . *Here's Why:*

Ex-Cell-O Precision Boring Machines are designed to produce more parts per hour, at lower unit cost. Increased output enables you to keep up with rising labor costs; assured accuracy in the finished part also results in greater savings.

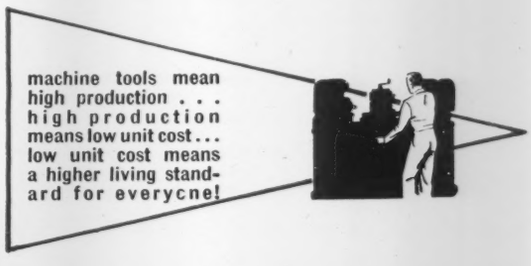
For example:

The Ex-Cell-O Style 2112-A Boring Machine illustrated here features three boring spindles, loading chutes that are filled during the boring cycle, and a hydraulically operated loading and ejecting device. The machine accommodates various size bushings up to 2″ diameter and 1¾″ long. Flexibility is obtained by adjustable loading chutes for various diameters, interchangeable clamping fixture inserts, interchangeable ends on loading and ejecting plungers, and interchangeable boring quills.

For high production at a minimum unit cost; for flexibility that permits profitable operation on a wide variety of parts—see the Ex-Cell-O representative in your locality or write to Ex-Cell-O at Detroit . . . *today!*



● Close-up view (above) of the three chutes and the loading and ejecting device.

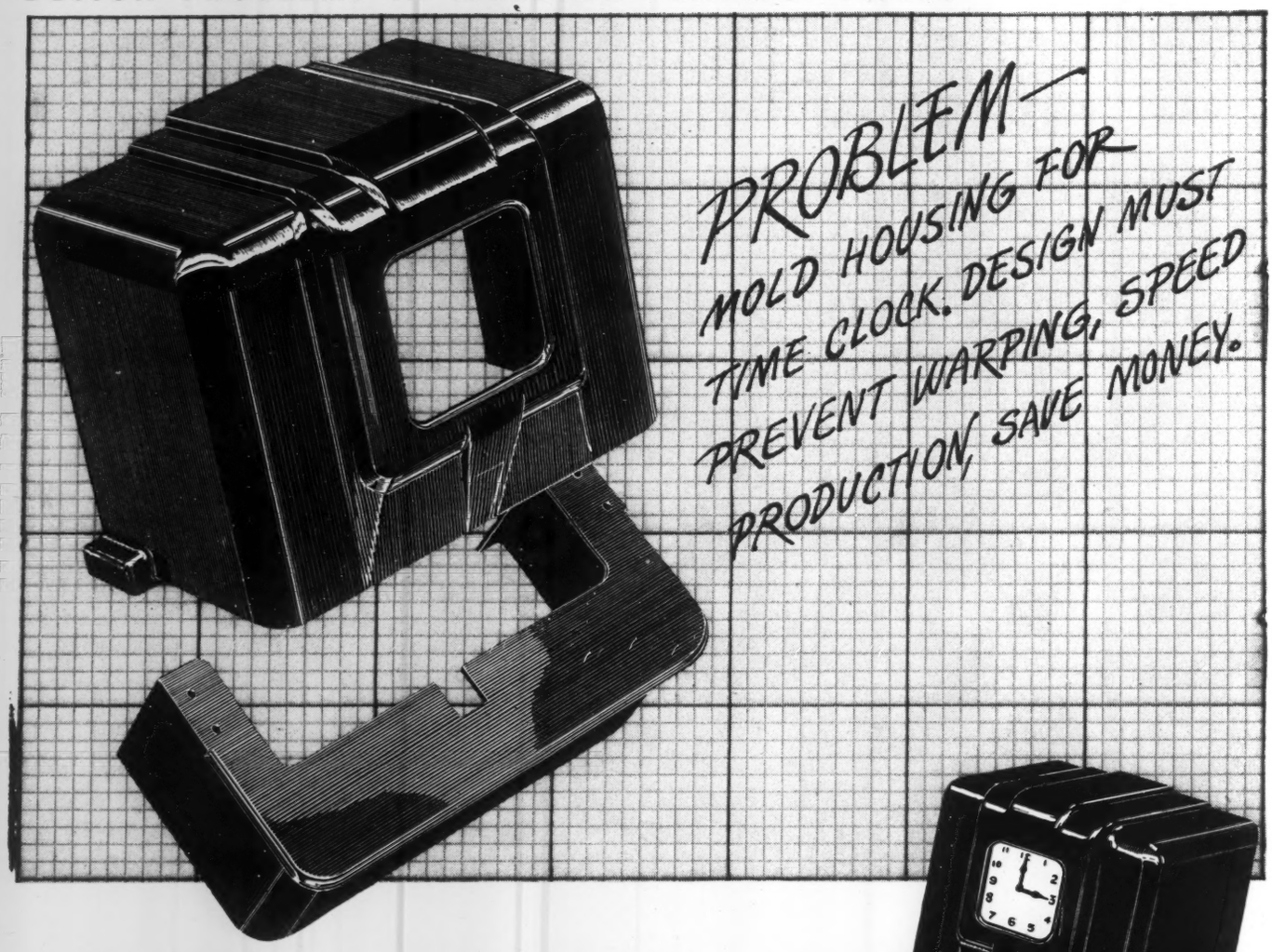


● This view (left) shows the three boring spindles with micrometer adjustable quills for fast tool setting, and the chute (between the spindles and the fixture) into which the finished bushings are ejected.

EX-CELL-O CORPORATION DETROIT 6 MICHIGAN

MANUFACTURERS OF PRECISION MACHINE TOOLS • CONTINENTAL CUTTING TOOLS • MISCELLANEOUS PRODUCTION PARTS • FUEL INJECTION EQUIPMENT • RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS • PURE-PAK PAPER MILK BOTTLE MACHINES

DESIGN PROBLEMS IN MOLDING PLASTICS PARTS



A NEW DESIGN FOR MARKING TIME

. . . AND *Saving* IT

• This plastics housing replaced one of metal for the Simplex Time Recorder . . . saved manufacturing and finishing time . . . contributed strength, precision, and economy with its unique design.

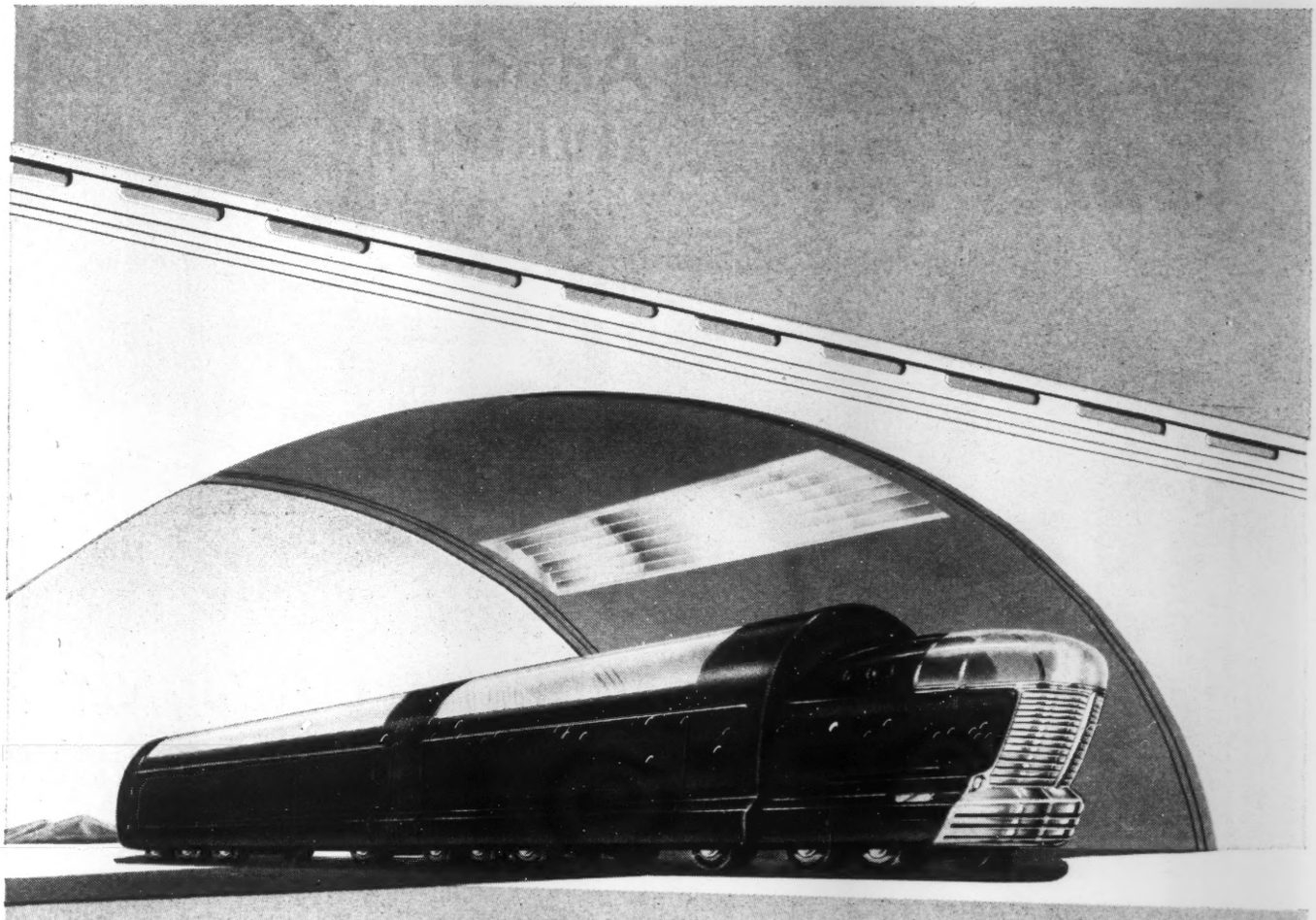
At No. 1 Plastics Avenue, General Electric compression-molded the housing of a black phenolic chosen for its qualities of toughness and handsome appearance. G-E engineers designed the parts for the greatest structural strength, reinforcing them inside to prevent warping. A special feature of the design permits the inclusion of metal inserts perpendicular to the direction of molding.

G-E engineers, experienced in plastics production problems like these, can help you solve similar problems. If you have a plastics product to design or redesign, bring it to General Electric—the world's largest manufacturer of finished plastics products. There you will get unbiased advice on all types of plastics and molding processes, plus other benefits of G. E.'s *complete* plastics service. Upon request, you will be sent a new G-E bulletin, "Design Data on Plastics for Product Designers." Write Section G-13, Plastics Divisions, Chemical Department, General Electric Company, 1 Plastics Avenue, Pittsfield, Massachusetts.

GENERAL ELECTRIC

CD 47-H9

EVERYTHING IN PLASTICS



Here comes tomorrow's trailer

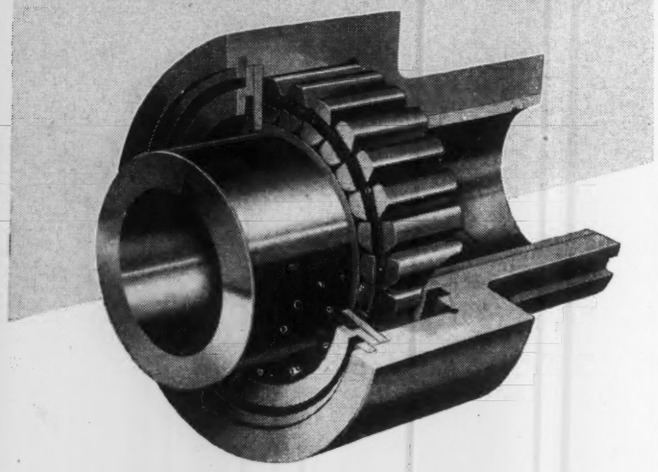
Designers and engineers find light alloys by Bohn have a great variety of operating advantages

BOHN

BOHN ALUMINUM & BRASS CORPORATION — GENERAL OFFICES, LAFAYETTE BUILDING, DETROIT 26, MICH.

Designers and Fabricators—**ALUMINUM • MAGNESIUM • BRASS • AIRCRAFT-TYPE BEARINGS**

Do You Need a REALLY GOOD



OVER-RUNNING CLUTCH?

If you have, or may have, an application, let us give you full information about

FORMSPRAG

THE FULL COMPLEMENT

Over-Running Clutch

You realize, as do we, that there are many applications where ordinary clutches serve the purpose.

But there are hundreds of applications where you need something better! You may need extremely high torque capacity in limited space. You may need a clutch that cuts in and out hundreds of times a minute. You may require such extreme accuracy in your production that only Formsprag will do the job properly.

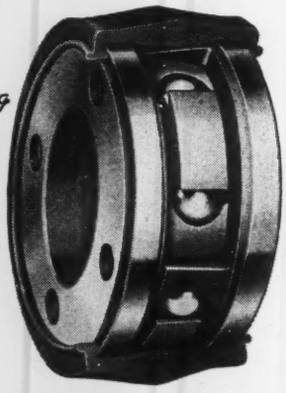
If you have a tough application — one that requires that "extra something" — it is well worth while to investigate Formsprag.

BALLFLEX

ANGULAR AND AXIAL

Anti-Friction Flexible Coupling

Ballflex, quickly installed between keyed flanges, accommodates parallel misalignment up to ⅛" and/or angularity up to 3°. It is packed with lubricant for the life of the unit. Flexibility is by mechanical means only. All torque is delivered by hardened steel balls. Free rolling movement in any direction eliminates side thrust and insures long life for both coupler and bearings

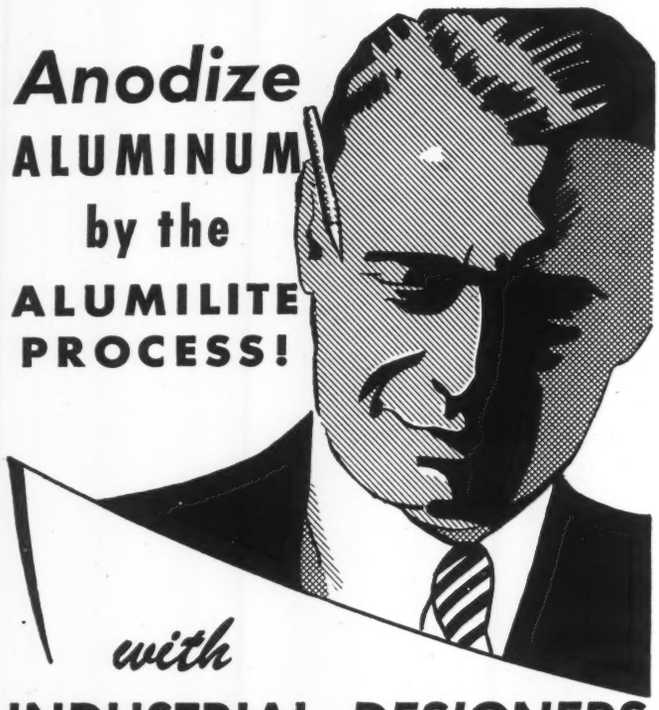


Folder On Request

FORMSPRAG *Company*

1415 JARVIS • FERNDALE, MICH.

Anodize ALUMINUM by the ALUMILITE PROCESS!



with

INDUSTRIAL *DESIGNERS* IT'S THE "FINISH" OF THE ALUMINUM PRODUCT *that counts!*

for CORROSION RESISTANCE

for HARDNESS

for BEAUTY

Whether your product is eminently an industrial product or whether it is a general consumer's item — it's the finish that plays an important part in product merchandising. Eye appeal goes hand in hand with wearability. We possess the necessary "know-how," which comes only from experience, to furnish an economical solution to your own particular problem. *Clear and Color Finishes Available.*

ALL INQUIRIES GIVEN PROMPT ATTENTION

WAGNER *Rustproofing* **COMPANY**

7700 QUINCY AVE. • CLEVELAND 4, OHIO

MORGANITE APPLIANCE BEARINGS

—strengthen product acceptance by assuring trouble-free service!

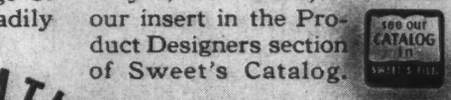
SELF-LUBRICATING BEARINGS AFFORD SMOOTH PERFORMANCE WITH COMPLETE FREEDOM FROM OILING AND GREASING MAINTENANCE CHORES

No need to pity the poor housewife... designers of modern appliances have remedied that! Nowadays, mechanical home equipment is designed —from door hinges to motor bearings—for enduring, uninterrupted service.

MORGANITE Appliance Bearings retain their self-lubricating properties throughout the life of the appliance, are immune to acid and alkaline corrosion and can withstand extremes of temperature without harm. They are particularly designed to the speeds and loads encountered in the home appliance field.

MORGANITE bearings are available in a wide range of materials. They can be readily molded to required tolerances. Simplification in appliance design, and a lower resultant cost, may be realized by use of standard types of bearings.

For complete information, address: MORGANITE INCORPORATED, Long Island City 1, New York, or consult our insert in the Product Designers section of Sweet's Catalog.



SELF-LUBRICATING

Perhaps your project is now in the blueprint or preliminary production stage — Morganite engineers will gladly collaborate in designing-in self-lubricating bearings.

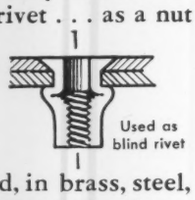
Morganite INCORPORATED

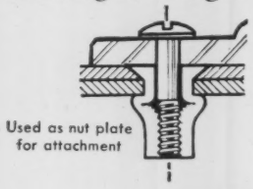
Write for literature describing the complete line of MORGANITE products, including motor and generator brushes.

CARBON SPECIALTIES

RIVNUTS LICK TOUGH FASTENING PROBLEMS

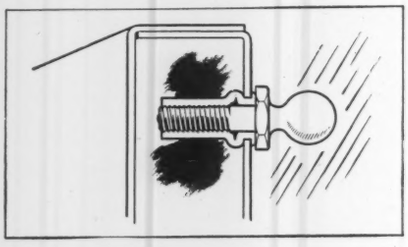
B. F. Goodrich Rivnuts are one-piece tubular rivets that easily solve some of the toughest fastening problems. Rivnuts are installed and headed while working entirely from one side . . . as a blind rivet . . . as a nut plate . . . or both! A ring-type bulge forms on the blind side which resists being pulled through the work, even under conditions of eccentric load. Light, strong Rivnuts are ready for use as received, in brass, steel, aluminum and splined aluminum —in a wide range of types, sizes and grips. Perhaps they can help you.

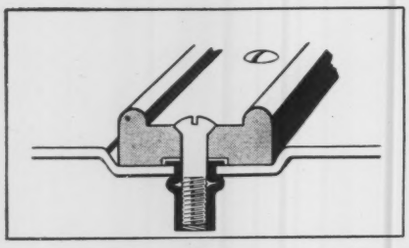




How RIVNUTS *Made 2 Jobs Easier*

Rivnut -A8-75. Used as a nut plate in sheet metal door of kitchen cabinet. Door knob of catch is threaded into clean Rivnut threads after upset. Job is quick, easy.





To hold truck floor strips, S 25-80 Rivnuts are used as nut plates. Rivnuts were headed in hexagon holes to prevent turning. Installation time and labor were saved.

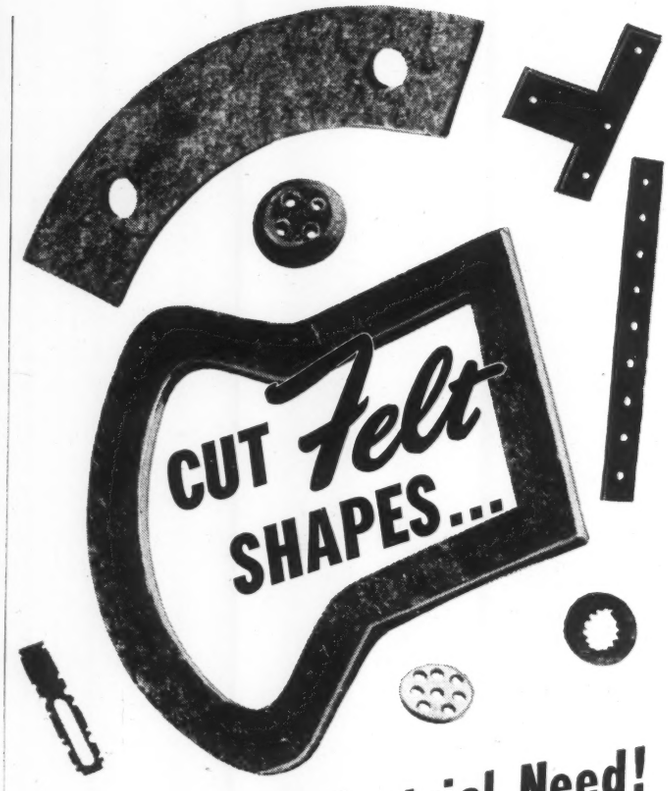
GET "RIVNUT DATA BOOK"

The whole Rivnut story. 40 illustrated fact-packed pages of installations, types, sizes, grip ranges, tools, test data. Write for your free copy to The B. F. Goodrich Company, Dept. MD-27, Akron, Ohio.

B.F.Goodrich

RIVNUTS

It's a rivet—It's a nutplate



For Every Industrial Need!

Designers find Western Felt useful for many component parts in which *extra* performance characteristics are essential. It's an unusually versatile material that can be processed to a wide range of specifications—*from wool soft to rock hard.*

Resilient, flexible or compressed—Western Felt has high resistance to water, oil, age, heat and wear. It cuts readily to any form and does not ravel, fray or lose its shape.

In one form or another, felt is used profitably in thousands of products for isolating vibration, absorbing sound, cushioning shock, filtering liquids, retaining liquids, etc. New uses are found daily.

Western Felt Works engineers are ready to help you on any problem involving the possible use of felt. Write, wire or phone today!

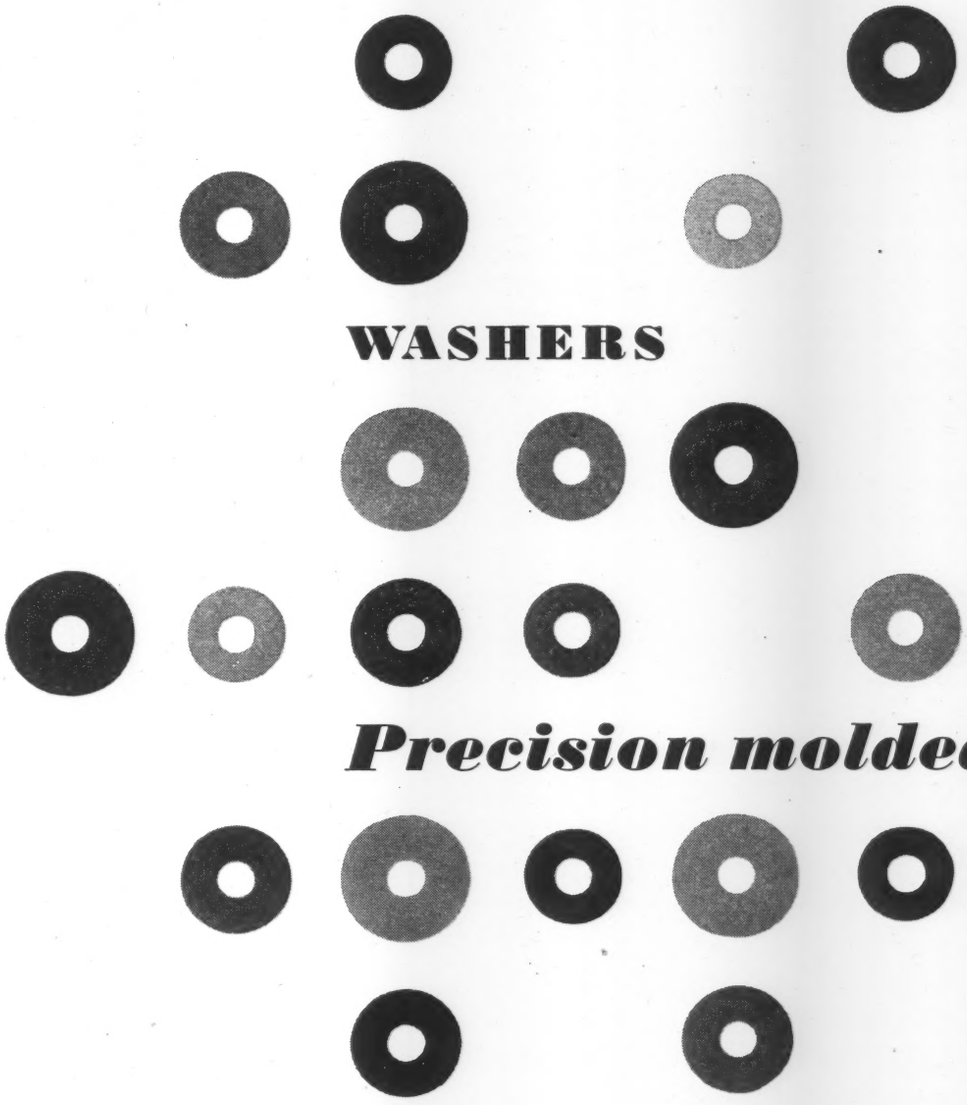
Acadia Synthetic Products Division, WESTERN FELT WORKS, Processors of Synthetic Rubber — Sheets, Extrusions and Molded Parts.

WESTERN FELT WORKS

4035-4117 Ogden Avenue, Chicago 23, Illinois

Branches in All Principal Cities

LARGEST INDEPENDENT MANUFACTURERS and CUTTERS of WOOL, HAIR and JUTE FELTS



WASHERS

Precision molded

Tough, yet resilient, these NYLON washers are another example of skill in molding Nylon to close tolerances.

When the Hall Products Co., of Clifton, New Jersey, designed these quality washers, Hall placed their production problems in the hands of Atlantic of New York.

Atlantic's success in molding difficult industrial products, offers significant answers to manufacturers with similar problems. Our engineers are available for consultation.

ATLANTIC
OF NEW YORK

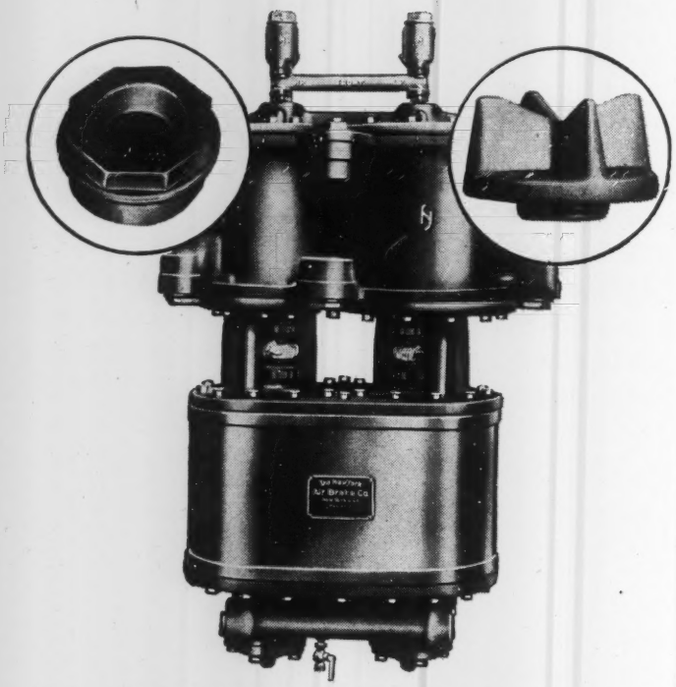
ATLANTIC PLASTICS, INC.

132-27 FORTIETH ROAD, FLUSHING, N. Y. • *"Here dwells ingenuity"*

AIR VALVES AND AIR VALVE SEATS

are made of toughest forgings —

NATIONAL DROP FORGINGS



The New York Air Brake Company makes outstanding compressors, known everywhere for remarkable service and efficiency.

Our forgings are used because they are skillfully made of steel of maximum toughness, strength and fatigue resistance.

National forgings have the requisite fibre-like grain structure reinforced at areas of greatest impact and wear.

Write us today for booklets describing our standard line of SAE yoke and rod ends, container handles and knife blades etc.:—and send us your inquiries for custom drop forgings.

The Trademark "N" is your guarantee of Fine Quality Forgings.

THE NATIONAL LOCK WASHER CO.

DROP FORGING DIVISION

NEWARK 5 NEW JERSEY

THE *Extra* HOLDING POWER IN CHICAGO "*SAFETY PLUS*"

In deciding what fastening to use in your products, consider the importance of the *extra* holding power in Chicago "Safety Plus" Socket Head Cap Screws. This "extra" results from the use of especially selected alloy steel, plus correct heat treating practice—combined with precision threading method designed to give full thread engagement.

The greater tensile strength of "Safety Plus" permits using fewer fastenings, resulting in a noticeable reduction in weight and a neater, sturdier construction in your products.

In addition, the smaller heads with internal wrenching permit locating "Safety Plus" screws in areas too small for protruding hexagon heads.

Make use of Chicago "Safety Plus" EXTRA strength to make your products EXTRA GOOD.

Chicago "SAFETY PLUS" line includes:

Socket Head Cap Screws • Socket Set Screws • Stripper Bolts • Square Head Dog Point Set Screws • Socket Pipe Plugs • Keys for "Safety Plus" Products.

Complete line includes:

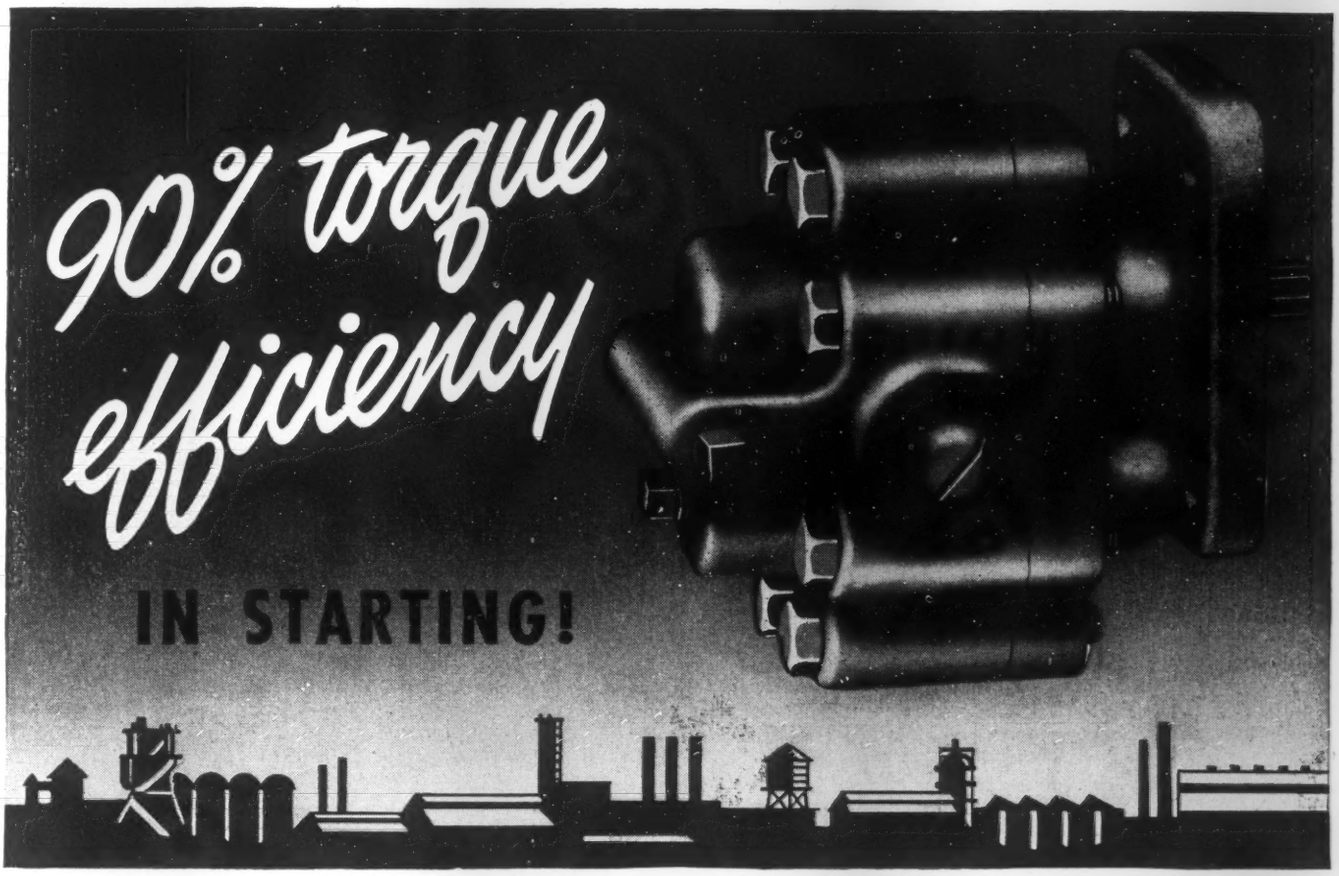
Hexagon Head Cap Screws • Square Head Cup Point Set Screws • Headless Set Screws • Fillister Head Cap Screws • Flat Head Cap Screws • Taper Pins • Milled Studs • Semi-Finished Hexagon Nuts • Semi-Finished Hexagon Castellated Nuts.

These Fine Products are sold only thru Authorized Distributors

THE CHICAGO SCREW CO.

ESTABLISHED 1872

1026 So. Homan Avenue Chicago 24, Ill.



...with this new Pesco Hydraulic Motor

If the operation of your equipment calls for the use of a hydraulic motor that can deliver better than 90 per cent torque efficiency in starting, it will pay you to get full information regarding this new Pesco Hydraulic Motor. Built to Pesco's high standards of technical excellence, it features in addition to its high starting torque efficiency, dual rotation, smooth operation, minimum parts and long life. It is non-stalling and exceptionally light in weight.

Its high starting torque efficiency makes it possible for this Pesco development to operate faster and more economically than conventional hydraulic motors. Its fewer parts mean minimum service requirements. Its light weight is a real advantage on any equipment on which it is installed. And, it provides a smooth, pulsation-free flow of power.

Built in sizes from 50 to 600 pounds inches torque, this motor will operate at working pressures up to 1500 p.s.i. and at operating speeds from 0 to 4000 r.p.m. For complete information regarding this, or other hydraulic power needs, write Dept. 27-H, PESCO PRODUCTS DIVISION, Borg-Warner Corporation, 16610 Euclid Avenue, Cleveland 6, Ohio.

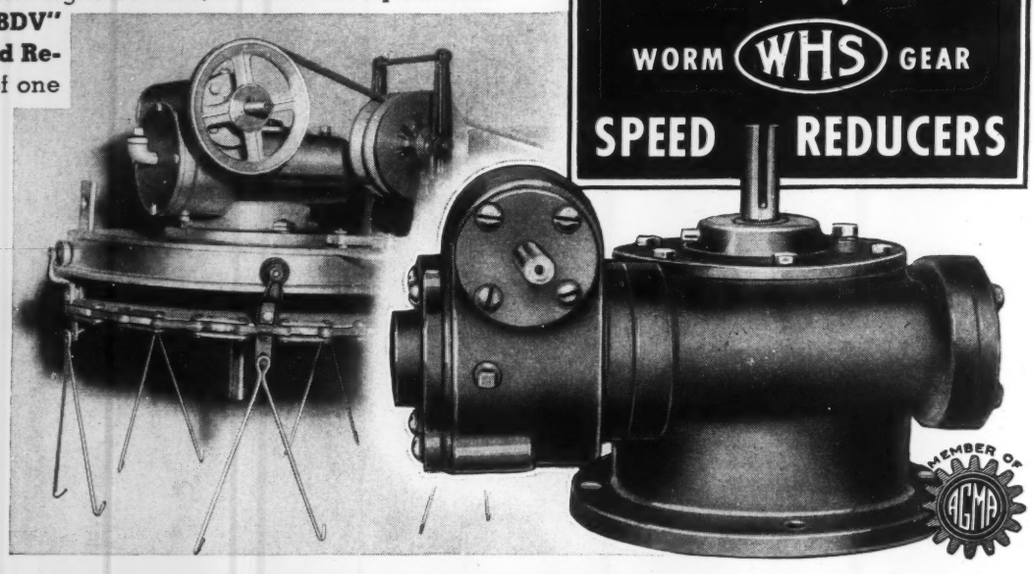
In Precision Hydraulics, Fuel Pumps, Air Pumps, Related Accessories and Aircraft Electric Motors . . . Performance Points to PESCO First.

Pesco PRODUCTS DIVISION
BORG-WARNER CORPORATION
11610 Euclid Avenue
Cleveland 6, Ohio
MANUFACTURERS OF BW SUPERCHARGERS

FLEXIBILITY... Yes! DURABILITY... of Course!

The motor drive on this Keystone Junior Conveyor (made by Beveridge Millwright Service, Detroit) incorporates a standard **WHS Series "BDV" Double Reduction Speed Reducer.** The movement of one lever gives a 7-1 variable speed. Result . . . the most flexible of all light duty overhead conveyors!

Just about any speed reduction problem can be solved by WHS . . . "The Most Complete Line of Speed Reducers Available from Any One Source" Have you our pocket Catalog No. 145?



DEPENDABILITY *Always!*

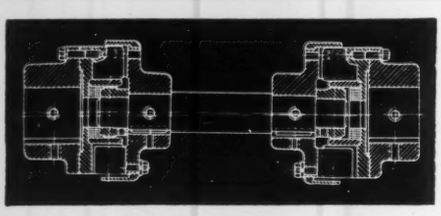
WORM WHS GEAR SPEED REDUCERS

MEMBER OF AGMA

WINFIELD H. SMITH CORPORATION

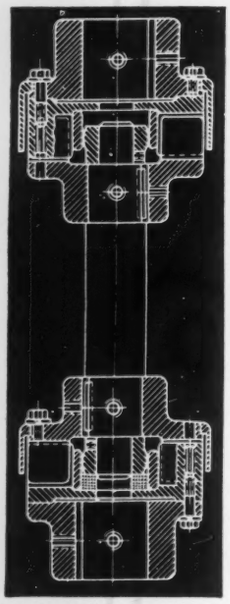
16 ELTON STREET . . . SPRINGVILLE . . . ERIE COUNTY . . . NEW YORK

Easy Line-up! . . . and Non-Lubricated



Type HKQ Floating Shaft Coupling. Operating Assembly, above horizontal, below vertical. For heavy duties, various distances. Pat. & Pats. Pend.

A basic function of Lovejoy Couplings is correction for misalignment. Simplifies line-up of drive and driven units. Means protection of equipment, least servicing. Never require lubrication.



LOVEJOY L-R Flexible Couplings

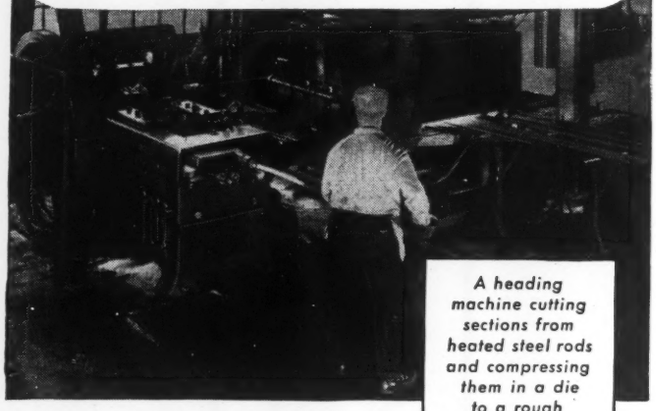
Eliminate troubles. Insure even dependable power-flow day-in and day-out. Most economical. Couplings for every kind of service, from 1/6 to 2500 h.p. Send for complete catalog, with Selector Charts. Help to find *your* couplings in a jiffy!

Lovejoy Flexible Coupling Co.

Also mfrs. of Lovejoy-Ideal variable Speed Transmissions.

5018 W. Lake St. **Chicago 44, ILL.**

This is How STROM BALLS are Born



A heading machine cutting sections from heated steel rods and compressing them in a die to a rough spherical shape

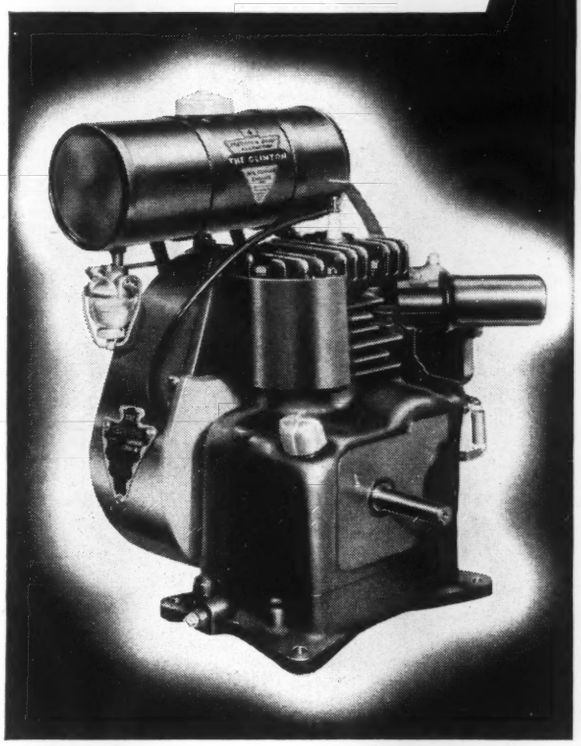
The steel is carefully chosen and inspected, even before it gets to the heading machine. After being "born" here, balls are carefully "brought up," through a long series of grinding and lapping operations, to the unbelievably high standards of finish, sphericity and precision which have made Strom Metal Balls the standard of industry. Strom Steel Ball Co., 1850 So. 54th Avenue, Cicero 50, Illinois.

Strom BALLS Serve Industry

Largest Independent and Exclusive Metal Ball Manufacturer

FOR POWER JOBS

It's the CLINTON ENGINE



1 to 2 horsepower
4-cycle—air-cooled

Far ahead in the field The CLINTON is outperforming other rated engines of the same HP and weight . . . It is considered the finest by users, dealers and manufacturers employing trouble-free, compact air-cooled power . . . The CLINTON enjoys an outstanding reputation for better performance, longer service and economy of operation . . . The CLINTON IS THE NEW STANDARD FOR MODERN ENGINES . . .

IMPROVEMENT OF DESIGN GIVES THE CLINTON THESE MODERN FEATURES

Dustproof Magneto **Fin-Type Manifold**
Super Finished Crank Shaft
Oil Filler on Top of Crankcase

See your dealer for new reduced price

Sales and Service Points Throughout United States and Canada

Write Department 200D

CLINTON SALES CO.

DONOVAN BLDG., DETROIT, MICHIGAN

4 IMPORTANT centrifugal pump FEATURES

1 Splash-proof motors... totally enclosed for protection from vapors, dust and moisture.

2 Permanently sealed ball bearings... no lubrication, adjustment, inspection, cleaning or other maintenance is needed. Precision seals lock in grease... lock out dirt.

3 Amply powered... sufficient h.p. to handle liquids up to 1000 S.S.U. at operating temperature.

4 Simple construction... strong and durable. Balanced hydraulically. Designs provide stability without a bearing at the impeller end of the shaft.

Write for complete information and installation dimensions. Brown & Sharpe Mfg. Co., Providence 1, Rhode Island, U. S. A.

No. 206

No. 240

B·S

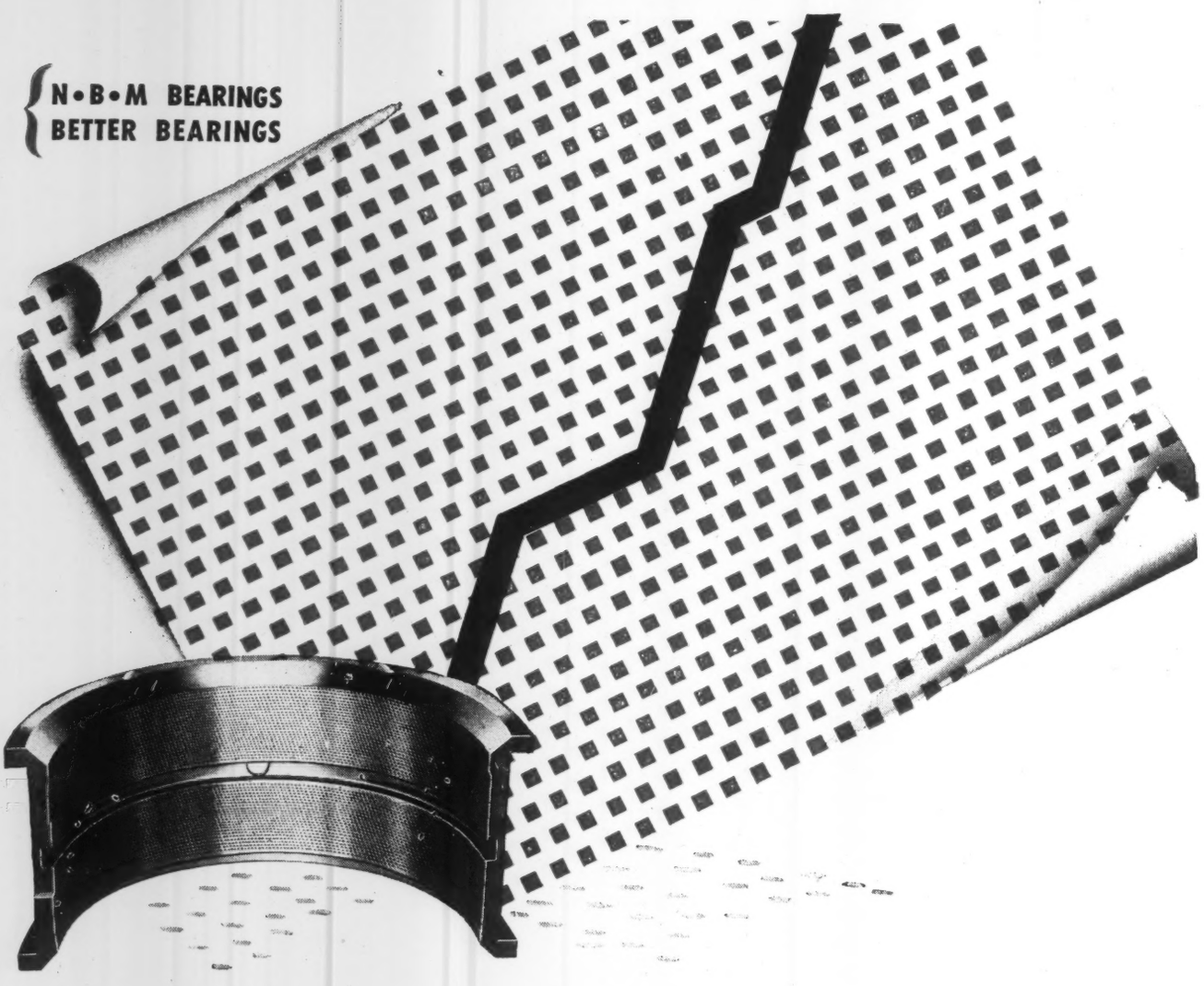
We urge buying through the distributor

No. 220

CENTRIFUGAL • GEARED • VANE • MOTOR DRIVEN

BROWN & SHARPE PUMPS

N•B•M BEARINGS
BETTER BEARINGS



N•B•M GRIDDED BEARINGS IMPROVE HIGH-SPEED, HEAVY-LOAD MACHINERY

Diesel engines and other high-speed, heavy-duty machinery can now be equipped with longer-lasting, smoother-running Gridded Bearings.

Special tools, developed by Brake Shoe Research, now produce uniformly-spaced-and-babbitted grids with automatic precision at "mass-production" savings. Now you can use Centrifugally Cast N-B-M Gridded Bearings freely wherever high speeds and heavy loads call for added fatigue strength and safety factor.

Write today for complete engineering data.

NBM

AMERICAN Brake Shoe COMPANY

NATIONAL BEARING DIVISION
ST. LOUIS • NEW YORK

PLANTS IN: ST. LOUIS, MO. • PITTSBURGH, PA. • MEADVILLE, PA. • JERSEY CITY, N. J. • PORTSMOUTH, VA. • ST. PAUL, MINN. • CHICAGO, ILL.

HELPFUL LITERATURE

FOR DESIGN EXECUTIVES

1. Thermostatic Control

Mu-Switch Corp. — 4-page illustrated bulletin describes various types of Ther-MU-trol snap action thermostatic controls for temperatures ranging up to 750 F. Specifications and application data are included.

2. Packings & Seals

Durametallic Corp. — 8-page illustrated folder No. 260A shows typical uses of engineered packings and briefly describes standard types of packings and seals for wide range of services and applications.

3. Hinged Gear Joint

Gray & Prior Machine Co. — 4-page illustrated bulletin shows details of hinged gear joint for hand operated remote controls or power transmissions up to ½-horsepower at angles from 3 to 139 degrees.

4. Gasoline Engines

McCulloch Motors Corp. — 8-page illustrated bulletin describes series 1200 die cast industrial gasoline engines which develop from 2½ to 4 horsepower. Details are given on standard and special engines which are adaptable for wide range of uses.

5. Tubing Coupling

Parker Appliance Co. — 4-page illustrated bulletin describes Ferulok flareless coupling which assures perfect connection with tubing. Couplings can be connected or disconnected without damage to parts. Engineering data and ordering information are given.

6. Screw Machine Parts

U. S. Automatic Corp. — 4-page illustrated bulletin lists facilities of this company for production of screw machine and other precision parts. Typical elements produced and manufacturers served are listed.

7. Jacket Water Coolers

Ross Heater & Mfg. Co. — 4-page illustrated bulletin No. 4922 offers complete information on type BCF lubrication oil and jacket water coolers for serving smaller sizes of diesel and gas engines, reduction gears, thrust bearings, turbines, hydraulic presses and other applications.

8. Flexible Couplings

Thomas Flexible Coupling Co. — 58-page illustrated engineering catalog on Thomas flexible couplings gives design and application data on flexible disk type units which eliminate cross pull on bearings, minimize friction and compensate for misalignment. Couplings are available in sizes and types for practically any service, horsepower or speed.

9. Blind Fasteners

B. F. Goodrich Co. — 36-page illustrated "Rivnut Data Book" covers construction, available styles and sizes, installation procedure and applications of these one-piece internally threaded and counterbored tubular rivets which can be upset from one side with simple tool. In addition to holding parts together, this blind fastener can be used as nut plate.

10. Snap Action Switches

Micro Switch Div., First Industrial Corp. — 108-page illustrated catalog No. 61 fully describes complete line and shows many uses of products. Different types of housings for snap action switches are listed. Details are given on actuators that make possible use of these products to make machines automatic, for machine limit and control, to aid in positioning materials, and to control electrical current and temperatures.

11. Reproduction Process

Eastman Kodak Co. — 4-page illustrated bulletin describes Kodak Transfax reproduction process for use with metals, plastics, plywood or pressed wood. Steps in using light-sensitive Transfax solution for transferring work diagrams, legends, designs or other line work from drawing to fabricating materials are explained.

12. Oil Filler Caps

Eynon-Dakin Co. — 4-page illustrated folder lists sizes and advantages of using self-sealing dust caps for oil tubes, oil holes, vents, oiling devices and filler necks. Caps are made of oil resistant synthetic rubber.

13. Multiple Drill Heads

International Research Corp. — 6-page illustrated bulletin "IRC Adjustable Spindle Work Heads" describes units which can be attached to any standard drill press. Each of several spindles is adjustable separately to suit any required hole pattern. Special attachments are available to increase number of spindles.

14. Aluminum Alloys

National Smelting Co. — 16-page illustrated bulletin on Ternalloy aluminum alloys gives properties and other data on this series of aluminum-magnesium-zinc alloys which possess high elastic properties. Data aids in proper utilization of these materials.

15. Steam Platens

Lukens Steel Co. — 4-page illustrated bulletin presents design and application information on line of steam platens having special shaped steam labyrnths which assure uniform surface temperature and rapid heat transfer. Wide range of designs and platen shapes or sizes is available.

16. Powder Metallurgy

Biad Powder Metallurgy Co. — 2-page material data sheet lists properties of copper, brass, iron, steel, copper-iron alloy, bronze, soft iron and permanent magnet powder metal material.

17. Weighing Feeders

Syntron Co. — 4-page illustrated bulletin "Automatic Batch Weighing" presents data on line of Weigh-Flow vibratory feeders. Details are given on net batch type units with rotating weigh hoppers, automatic batch weigh plants and Gravimetric feeder machines.

18. Seam Welders

Progressive Welder Co. — 8-page illustrated bulletin No. 803 covers design, operation and applications of line of standard and special seam welders which are available in light, medium and heavy duty models.

19. Electric Components

Sylvania Electric Products Inc., Electronic Div. — Illustrated 4-page bulletins No. EC-24 and EC-23 describe hydrogen thyratron and electronic flash tubes respectively. Operating circuits, performance data and application information are given.

20. Hydraulic Pump

Pesco Products Co. — 2-page illustrated bulletin No. 108 tabulates performance data on model No. 051002-010 all purpose hydraulic pump which can be used wherever hydraulic power is needed. Capacity is 6 gallons per minute at 1000 pounds per square inch pressure.

21. Welding Facilities

American Welding & Mfg. Co. — 16-page illustrated bulletin entitled "American Welding" describes facilities and production of company. Pictures show welding, heat treating, fabricating and research activities and examples of application of controlled technique welding.

FIRST CLASS
PERMIT No. 86
(Sec. 510 P.L.&R.)
Cleveland, Ohio

BUSINESS REPLY CARD
No Postage Stamp Necessary if Mailed in the United States

4c POSTAGE WILL BE PAID BY—

MACHINE DESIGN
Penton Building
Reader's Service Dept. CLEVELAND 13, OHIO

MACHINE DESIGN 2-47
1213 West Third St., Cleveland 13, Ohio

1	11	21	31	41
2	12	22	32	42
3	13	23	33	43
4	14	24	34	44
5	15	25	35	45
6	16	26	36	46
7	17	27	37	47
8	18	28	38	48
9	19	29	39	49
10	20	30	40	50

Please have literature circled at left sent to me.

NAME _____ TITLE _____

COMPANY _____

MACHINES MANUFACTURED _____

ADDRESS _____

CITY AND STATE _____

This card MUST be completely filled out. Please TYPE or PRINT

22. Power Transmission

Boston Gear Works, Inc. — 320-page illustrated general catalog No. 54 carries data on complete line of power transmission equipment and component machine parts. Specifications and prices are given on stock sizes of spur, bevel, miter, helical and worm gears and worms; chains and sprockets; Reductor speed reducers; motorized Ratiomotor speed reducers; couplings; pulleys; pillow blocks; ball bearings; etc.

23. Meters & Controllers

Taylor Instrument Cos. — 28-page illustrated bulletin No. 98175 describes line of instruments for flow measurement, control and transmission. Details are given on recording, indicating and integrating flow meters, controllers and transmitters. Typical installations in all types of equipment and industries are shown.

24. Machine Drives

Speed-Drives, Inc. — 4-page illustrated folder "Power-Flo Products Engineered to Fit the Job and the Machine" discusses features of drives for incorporation in original machine design and for modernization of existing machines. They can be furnished in sizes to meet power requirements ranging from ½ to 20 horsepower.

25. Wire Cloth & Screen

Cambridge Wire Cloth Co. — 32-page stock list of No. 600 tabulates information on wire cloth and metallic screen materials which are available for immediate shipment. Data are given on items of steel, galvanized wire, brass, bronze, copper, Everdur, Inconel, Monel metal, nichrome, nickel and various stainless steel analyses.

26. Drawing Machine

Pomeroy Stereograph Co. — 4-page illustrated folder shows by example how three-dimensional drawings can be produced speedily and accurately from plan views through use of Stereograph drawing machine.

27. Hydraulic Fuses

Simmonds Aerocessories, Inc. — 4-page illustrated bulletin gives details of hydraulic fuses which are safety shut-off devices for aircraft hydraulic systems and for various industrial applications. Both return flow and quantity measuring types are detailed.

28. Laminated Plastics

Taylor Fibre Co. — Illustrated catalog and manual "Taylor Laminated Plastics" covers properties and processing of various types of laminated plastics including vulcanized, phenol and phenolastic fibers as well as silent gear materials. Dielectric characteristics of materials are covered to guide in their use by designers and engineers in electrical field.

29. Industrial Controls

Master Electric Co. — 20-page illustrated bulletin No. 200 contains general information, price data, dimension drawings and other information on across-the-line alternating current magnetic starters.

30. Capacitor Motor

Brown Brockmeyer Co. — 2-page illustrated data sheet No. 5077 on Power Poise capacitor motors lists dimensions and explains design features of these motors which are available in fractional sizes.

31. Electric Controls

Ward Leonard Electric Co. — 8-page illustrated bulletin No. 100,000 presents brief descriptions and engineering data on line of electric control devices which includes alternating and direct current starters, voltage and speed regulators, resistors, ring and plate rheostats, switches, magnetic contactors, relays and dimmers.

32. Reverse Switches

Euclid Electric & Mfg. Co. — 2-page illustrated bulletin No. 1002A presents information on handle operated and pendant mounted thumb operated reverse switches which are suited to many light duty applications on machine tools, small hoists and similar equipment.

33. Rolled & Welded Steel Parts

Cleveland Welding Co. — 8-page illustrated bulletin entitled "Cleve-Weld Circular Rolled and Welded Steel Products" describes production facilities of company and shows typical parts which include gear ring blanks, flame cut gears, motor and generator frames as well as special items. Specifications are given on line of tractor and truck rims.

34. Springs

Accurate Spring Mfg. Co. — 36-page illustrated "Accurate Handbook of Technical Data on Springs" is designed to conserve time of engineers and others interested in springs. Most generally usable data and information concerning spring design and purchase are presented. Design formulas, load deflection tables, spring specifications, wire gages and related facts are tabulated.

35. Vibration Control

L. N. Barry Co. — 8-page illustrated bulletin "Vibration and Shock Control" pictures and describes engineering and manufacturing facilities of company, shows typical custom designed Barrymounts for vibration control and gives application data on standard units for wide range of service.

36. Lubrication System

Alemite Div., Stewart-Warner Corp.—8-page illustrated bulletin No. 22-94 describes Alemite Dual Manifold system of lubrication which is suited for medium and heavy duty machines. Positive metered lubrication is provided to bearings throughout machines. From light oils to heavy greases can be handled under extremes of heat and cold.

37. Electric Cord Protector

Eastman Mfg. Co. — 4-page illustrated bulletin No. 46-E describes Eastman strain reliever for electric cords and cables. Specifications and replacement parts are given for this device which protects electric cords where they enter tools or appliances and prevents wires from pulling loose from terminals.

38. Gravity Conveyors

Rapids-Standard Co. — 4-page illustrated folder No. RR-146 explains how Rapid-Roller gravity conveyor is adapted particularly to handling of boxes, crates, cans with chime edges, kegs and other irregularly surfaced items. Specifications for conveyor sections and Q series adjustable stands used for supporting conveyors are listed.

39. Fluid Drive

American Blower Corp. — 20-page illustrated bulletin No. 7019 contains complete information on Gyrol types VS and PE fluid drives for variable speed applications in higher horsepower range. Use of drives for fans and blowers, centrifugal pumps, centrifugal compressors, test stands and constant torque machines is discussed.

40. Self-Lubricating Bearings

Neveroil Bearing Co. — 12-page illustrated catalog No. 12 discusses applications, operating conditions, clearances, installation and other data on self-lubricating bearings, bushings and machine parts of Woodex impregnated wood. Graphex metal alloy bearings, bushings and parts are described.

41. Hydraulic Power Unit

Geo. D. Roper Corp. — 4-page illustrated bulletin No. 11 on Roper Hydraulic Pac gives details of this hydraulic power unit which is designed especially for use on farm tractors to operate manure loaders, hay loaders, cultivators, post pullers, plows, scrapers, etc.

42. Gages & Thermometers

Jas. P. Marsh Corp. — 20-page illustrated pamphlet shows and describes pressure, vacuum, compound, altitude, hydraulic and ammonia gages; diaphragm attachments; and remote reading and rigid stem dial thermometers for variety of industrial uses.

43. Capacitor Motors

Emerson Electric Mfg. Co. — 4-page illustrated bulletin No. X5526 describes complete line of capacitor start electric motors which are available in fractional horsepower sizes. Construction, design features, types of mountings, dimensional and NEMA standards are given.

MACHINE DESIGN 2-47

1213 West Third St., Cleveland 13, Ohio

1	11	21	31	41
2	12	22	32	42
3	13	23	33	43
4	14	24	34	44
5	15	25	35	45
6	16	26	36	46
7	17	27	37	47
8	18	28	38	48
9	19	29	39	49
10	20	30	40	50

Please have literature circled at left sent to me.

NAME TITLE

COMPANY

MACHINES MANUFACTURED

ADDRESS

CITY AND STATE

This card MUST be completely filled out. Please TYPE or PRINT

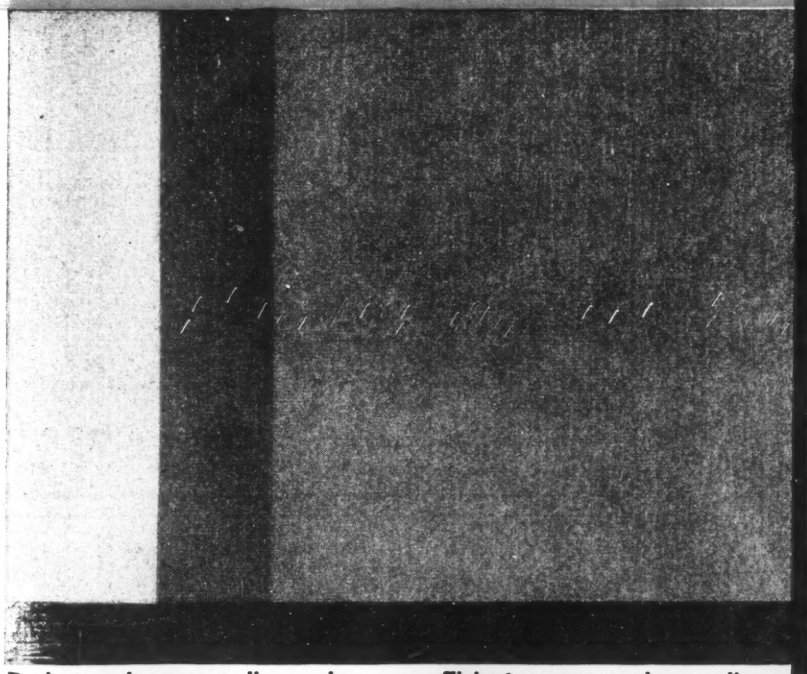
FIRST CLASS
PERMIT No. 86
(Sec. 510 P.L.&R
Cleveland, Ohio

BUSINESS REPLY CARD
No Postage Stamp Necessary if Mailed in the United States

4c POSTAGE WILL BE PAID BY—

MACHINE DESIGN
Penton Building
Reader's Service Dept. CLEVELAND 13, OHIO

HUNDREDS OF CONTROL PROBLEMS SOLVED WITH STEPPING RELAYS

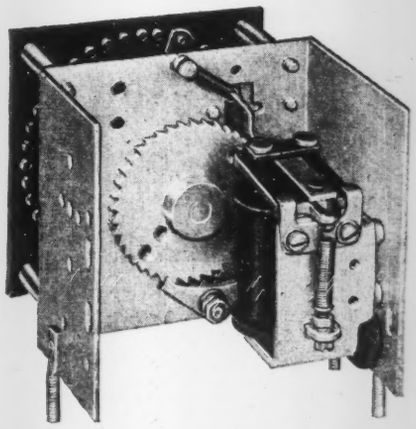


Design engineers are discovering new, efficient, money-saving applications daily for Guardian basic-type Stepping Relays. Typical applications include Automatic Sequence selection of circuits; Automatic Sequence cross connection of circuits; circuit control of Automatic Business Machines; control of Production Totalizing and Conveyor equipment; remote selection of records on Coin Operated Phonographs; Automatic Circuit Selection controlled from a pulsing dial; Automatic Wave Changing on short wave transmitters. This Guardian Stepping Relay is furnished for three basic types of A.C. and D.C. operation: Continuous Rotation—Electrical Reset—Add and Subtract. On each of these types the contact finger rotates in a counter-clockwise direction and all three types are designed to follow 10 pulses per second within the rated voltage range of the relay. Special construction prohibits skipping or improper indexing of the ratchet. Guardian Steppers may be furnished as separate units; in combination with relays, contact switches, solenoids, etc., completely assembled and wired to terminals; mounted on special bases or in enclosures. Any *standard* Guardian Stepping Relay can be modified to meet practically all "special" stepper control applications where quantities warrant special designing. For complete details write for Bulletin SR.

GUARDIAN ELECTRIC

1601-B W. WALNUT STREET CHICAGO 12, ILLINOIS

A COMPLETE LINE OF RELAYS SERVING AMERICAN INDUSTRY



GUARDIAN SERIES R

1 Continuous Rotation

In this type the contact finger advances one step each time the circuit is made and broken. Weight approximately 20½ ozs.

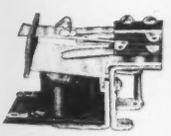
2 Electrical Reset

Resets when a second coil is energized. Weight approximately 23 ounces.

3 Add and Subtract

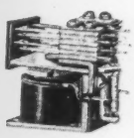
Steps back one or more contacts at a time instead of resetting completely. Weight approximately 28½ ounces.

TYPICAL GUARDIAN UNITS AVAILABLE IN COMBINATION WITH GUARDIAN STEPPERS

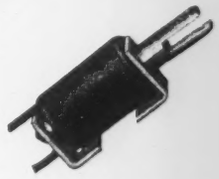


Series 100 Snap-Action Relay

Guardian Featherub Switch



Series 500 Midget Relay



Series I-A Solenoid

Advice

about your speed-control problem is yours for the asking!

When you
Look to Lewellen
you employ the pioneer
in speed-control

Wire, phone or write
LEWELLEN MFG. CO.
Columbus, Indiana

LEWELLEN

Variable-Speed

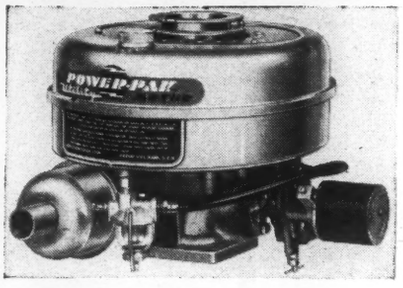
TRANSMISSIONS - MOTOR PULLEYS

Power It with . . .

POWER-PAK

GASOLINE UTILITY MOTOR

- 2 hp. at 4000 rpm.
- Precision-Built
- Light Weight
- Compact
- Rugged



DESIGNED TO MEET MODERN DEMANDS!

Here's a modern-to-the-minute, precision-built, gasoline motor especially fitted to the needs of industrial designers and manufacturers making machines and equipment requiring 2 H. P.

POWER-PAK is compactly designed, light weight (only 19 lbs.), every piece and part of finest materials to insure long, smooth, trouble-free operation. Overall length 14⅜", width of cowling 9½", height 8¹¹⁄₁₆". Easily installed . . . economical on fuel . . . easy access to all vital parts. Replacement parts always in stock. Let POWER-PAK solve your power problem.

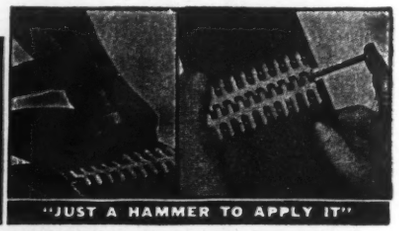
AVAILABLE NOW . . . GET FULL FACTS

Write today for Illustrated Literature, full details and prices on the POWER-PAK.

PROPULSION ENGINE CORP.

Dept. 1076, 7th and White Eagle Road, Kansas City, Kans.

BELT LACING and FASTENERS for transmission and conveyor belts



"JUST A HAMMER TO APPLY IT"

ALLIGATOR

Trade Mark Reg. U. S. Pat. Office

STEEL BELT LACING

World famed in general service for strength and long life. A flexible steel-hinged joint, smooth on both sides. 12 sizes. Made in steel, "Monel Metal" and non-magnetic alloys. Long lengths supplied if needed. Bulletin A-60 gives complete details.

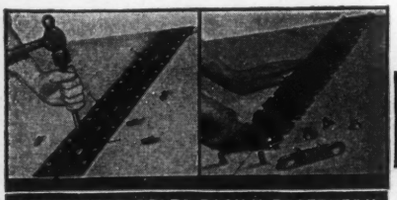
FLEXCO HD

BELT FASTENERS AND RIP PLATES

For conveyor and elevator belts of all thicknesses, makes a tight butt joint of great strength and durability. Compresses belt ends between toothed cupped plates. Templates and FLEXCO Clips speed application. 6 sizes. Made in steel, "Monel Metal", non-magnetic and abrasion resisting alloys.

By using Flexco HD Rip Plates, damaged conveyor belting can be returned to satisfactory service. The extra length gives a long grip on edges of rip or patch. Flexco Tools and Rip Plate Tool are used. For complete information ask for Bulletin F-100.

Sold by supply houses everywhere



"CONVEYOR BELTS EASILY FASTENED"

FLEXIBLE STEEL LACING CO.

4686 Lexington St., Chicago, Ill.

WHEN YOU DESIGN

Keep in mind **B&L WIDE FLATS**

SQUARES
Sizes: 1/4" up to 4" inclusive. Sizes over 4" on application.

WIDE FLATS
Sizes: 1/8" to 2" in thickness, and up to 6" in width.

EXTRA WIDE FLATS
Sizes: 1/4" to 2" in thickness, sizes over 6" to 12" in width.

STANDARD FLATS: All Sizes

They are cold drawn to accurate size, uniform section, true flatness and smooth even surface with sharp, square corners . . . an assurance of economy and precision that will carry over into your product.

Another advantage is the broad range of sizes in which they are available . . . so that you can always order close to your specified dimensions, and thus save on machining, reduce scrap loss, and economize during assembly.

Next time you have a job involving any flat parts . . . as in pattern plates, die blocks, jigs and fixtures . . . specify B&L Wide Flats, Extra Wide Flats, Standard Flats or Squares, as the case may require.

BLISS & LAUGHLIN, INC.

HARVEY, ILL. • BUFFALO, N. Y. MANSFIELD, MASS.

Sales Offices in all Principal Cities

EWC WHEELS

Engineered for YOUR Product

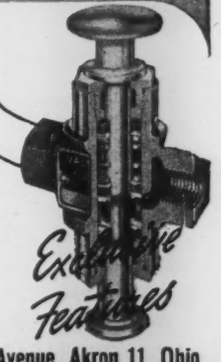
There is a wide variety of EWC wheels and axles for every type of mobile equipment . . . one or several may be ideally suited to your product. For unusual wheel problems, we offer you a complete engineering service, with a thoroughly experienced staff and unexcelled facilities. Write today for complete information.

ELECTRIC WHEEL CO., Quincy, Illinois, Est. 1890

NO LEAKS AFTER 2,000,000 OPERATIONS

Using **VALVAIR**

Diagram shows press operated by 2-pressure hydraulic valve with automatic H. P. inlet valve. Hydraulic valve controlled by Valvair knob-operated valve.



Exclusive Features

Standard Valvairs have operated more than 2,000,000 times at 100 lbs. pressure *without a leak.* . . . No metal seats; non-corrosive. No air flow restrictions. Many control combinations on either end. 5 sizes, 1/4" to 1"; 3 types; 8 designs. Get facts and prices.

Ask For Bulletin A-D.

VALVAIR CORPORATION • 454 Morgan Avenue, Akron 11, Ohio

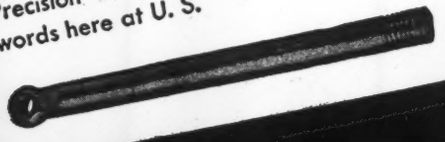
Valvair

4-WAY 4-WAY

Millions of adapters for millions of machines of all kinds—that's U. S. If you have a screw machine part problem, send your print to us.

U. S. AUTOMATIC CORPORATION
AMHERST, OHIO

Every special bolt is a "job" in itself. Precision and production are the key words here at U. S.

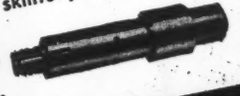


U. S. AUTOMATIC CORPORATION
AMHERST, OHIO

There are all kinds of pins from hatpins to bowling pins, but when it comes to pins like this one, we're the people who can make them for you.

U. S. AUTOMATIC CORPORATION
AMHERST, OHIO

A fraction of an inch means a great deal to a shaft. If a shaft is faulty it may cause serious difficulties in a short time. Exactly made, skillfully heat treated and perfectly ground screw machine parts.



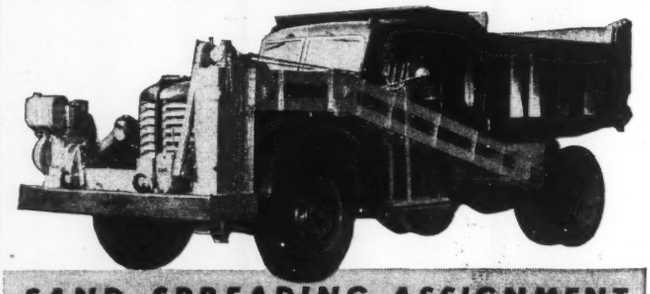
U. S. AUTOMATIC CORPORATION
AMHERST, OHIO

Superior SPECIALIZES, TOO!

The layman never ceases to admire the fine skill of those who make and service timepieces. Specialization, if you please.... It is our job to "prescribe" the one carbon brush grade that will give you peak performance. Into every recommendation goes a 27-year acquaintance with this important subject.

SUPERIOR CARBON PRODUCTS, Inc.
9117 George Ave., Cleveland 5, Ohio

"Since 1914" SUPERIOR CARBON BRUSHES



SAND-SPREADING ASSIGNMENT
Handled by SINGLE CYLINDER Heavy-Duty
WISCONSIN Air-Cooled ENGINE

This unique piece of equipment is a street and highway sander, designed and manufactured by Carroll Machine Works, St. Paul, Minn. Powered by a Model *AHH* single cylinder Wisconsin Air-Cooled Engine, this machine has a capacity up to 1 cu. yd. per minute, and spreads material evenly, in a full circle or directionally from 8 to 30 ft.

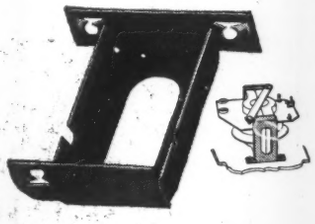
In this type of outdoor operation, it is vitally important, of course, that the power unit not only be of rugged, HEAVY-DUTY design and construction, but also that it be adapted to ALL-WEATHER SERVICEABILITY. These are factors that are *basic* in all Wisconsin Engines.

Wisconsin Heavy-Duty Air-Cooled Engines are made in a complete range of sizes (single cylinder and 4-cylinder models) from 2 to 30 hp. Descriptive literature on request.

Most H.P. per pound WISCONSIN MOTOR
Corporation
MILWAUKEE 14, WISCONSIN, U. S. A.
World's Largest Builders of Heavy-Duty Air-Cooled Engines

This is a SPEED NUT*.....

and



THIS is also a Speed Nut!*

Of course you recognize the Standard SPEED NUT, but just look at the "nightmare" our engineers dreamed up, to provide multiple fastening and operational functions in a single unit! It is used in the assembly of television transformers. It eliminates special mounting brackets and hard-to-handle threaded nuts and lock washers.

In addition to the widely-used standard types of SPEED NUTS, hundreds more are *functionally* designed to combine operations, eliminate parts, speed-up production, reduce final costs.

There must be some step in the assembly of your product where SPEED NUTS could reduce costs and improve your product. Send us your assembly details, or send in the parts for a complete fastening analysis . . . at no cost.

TINNERMAN PRODUCTS, INC.
2085 FULTON ROAD CLEVELAND 13, OHIO

Speed *Nuts**

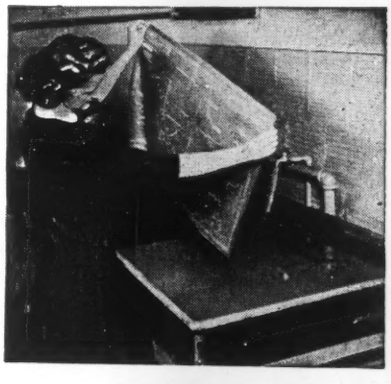
MORE THAN 4000 SHAPES AND SIZES — PATENTED

*Trade Mark Reg. U. S. Pat. Off.

FASTEST THING IN FASTENINGS

HI-TENSED Blueprints

[Replacing Potash]
Are Sharper—Clearer
Hold Color Longer—
SOLUTION IS NON-STAINING NON-CORROSIVE



OPERATOR IS Protected Against "BLUEPRINT RASH"

Hands can be completely immersed in *Hi-Tense Concentrate* Blueprint Developing Solution without danger of irritation or caustic dermatitis. Doesn't stain equipment, walls or clothing. Non-corrosive to tank, equipment or plumbing. Produces exceptionally sharp, clear blueprints. Pint bottle makes 40 gallons of solution. Consistently used by leading industrial concerns. Try a case of 6 bottles at $8.10. Order from your drafting supply jobber—or *direct*, if he can't supply you.

WISCONSIN PHARMACAL CO.
221 N. Water Street, Milwaukee 2, Wis.

PUSH-PULL GIVES REAL AID IN MACHINE DESIGN—NOW A PRACTICAL SOLUTION TO REMOTE CONTROL

Tru-Lay Push-Pull introduces to machine designers an improved means of transmitting reciprocal movement—mechanically—through flexible metal conduit. It is *precision-made*, and not to be confused with ordinary "choke control" construction—music wire with coiled wire conduit.

DETROIT, MICH.—The TRU-LAY Push-Pull now offered was originally developed for aircraft controls and is extensively used on airplanes being made today.

Push-Pull has many other varied applications—on motor vehicles, earth-moving equipment, moving and stationary machines of various kinds.

Some controls require only a simple rod. Others require complicated electric, pneumatic or hydraulic systems. Between these two extremes lie hundreds of uses for TRU-LAY Push-Pull. A feature particularly liked by machine designers is the greater freedom our Push-Pulls allow in the placing of units or accessories.

Read our booklet on TRU-LAY Push-Pulls. Then contact us for further information—our engineers will be glad to work with yours. If you have not yet received a copy of this booklet, just write to our Detroit Office.

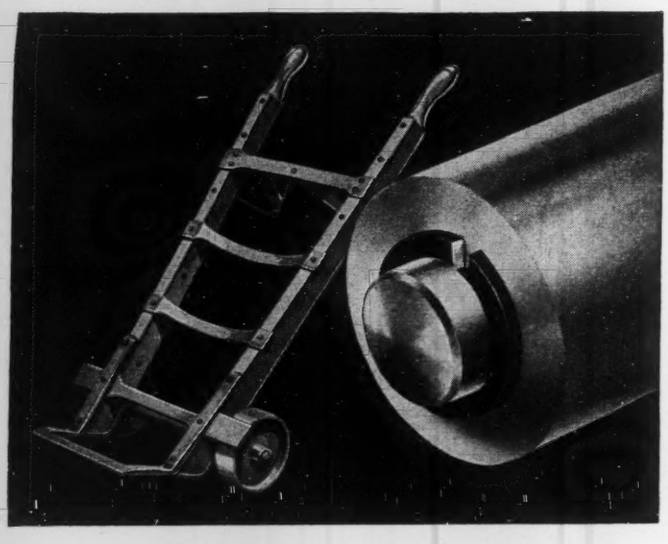
ACCO
6-235 General Motors Bldg., Detroit 2
695 Bryant Street, San Francisco 7 • Bridgeport, Conn.

AUTOMOTIVE AND AIRCRAFT DIVISION
AMERICAN CHAIN & CABLE

TRADE MARK

In Business for Your Safety

LET LESS METAL MAKE MORE MONEY



It's expensive to hold a mechanism in place with unnecessarily big shoulders or collars,—or to temporize with small cotter pins, etc. Let us show you how spring steel retaining rings can do a thoroughly efficient job for you.

More and more retaining rings are being used in these days of necessary economy. Every ounce of metal and every cent of cost is more important today than ever before.

It is needless waste in most instances to turn your shoulders by cutting down larger shafts, when you can groove a smaller shaft and apply a spring steel retaining ring. You'll get excellent results at unbelievable savings.

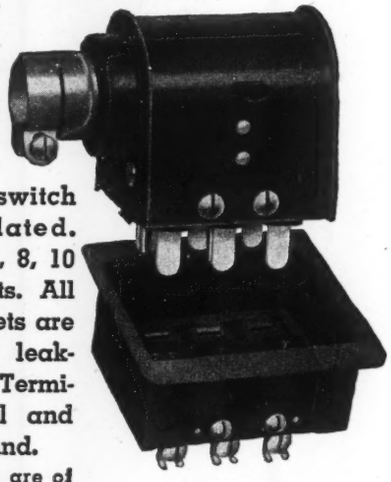
Every shoulder on your machines or on your metal products should be examined to see whether or not smart engineering could take advantage of these modern artificial shoulders on shafts or in housings.

Write today for our descriptive folder on Retaining Rings.

THE NATIONAL LOCK WASHER COMPANY
Newark, N.J., Milwaukee, Wisc., U.S.A.

JONES 500 SERIES PLUGS AND SOCKETS
(HEAVY DUTY)

Designed for 5000 Volts and 25 amperes per contact. Socket Contacts are of phosphor bronze, knife switch type, silver plated. Made in 2, 4, 6, 8, 10 and 12 Contacts. All Plugs and Sockets are Polarized. Long leakage path from Terminal to Terminal and Terminal to ground.



Plug P-506-CE
Socket S-506-DB

Caps and Brackets are of steel, parkerized. Plug and Socket blocks interchangeable in Caps and Brackets.

This series is designed for heavy duty electrical work and will withstand severest type of service. Accessibility a feature.

Write for Bulletin No. 500 describing this line of Heavy Duty Plugs and Sockets. Also ask for general catalog No. 14.

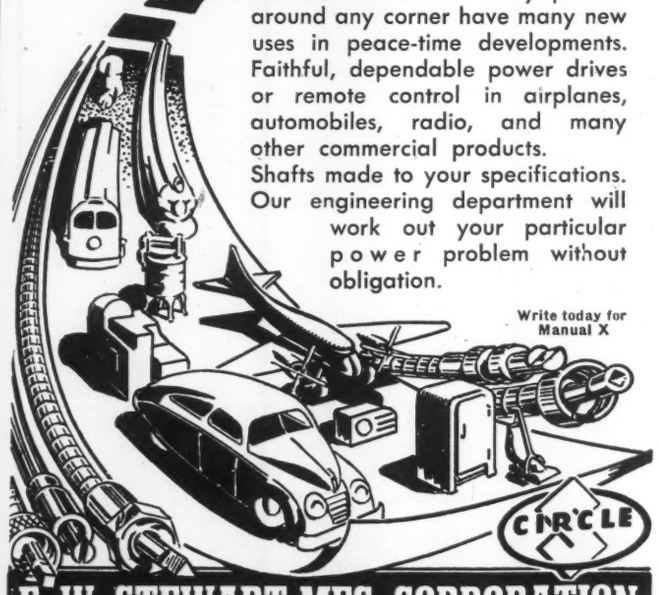
HOWARD B. JONES DIVISION
CINCH MFG. CORP.
2460 W. GEORGE ST. CHICAGO 18

FLEXIBLE SHAFTS

Flexible Shafts that carry power around any corner have many new uses in peace-time developments. Faithful, dependable power drives or remote control in airplanes, automobiles, radio, and many other commercial products.

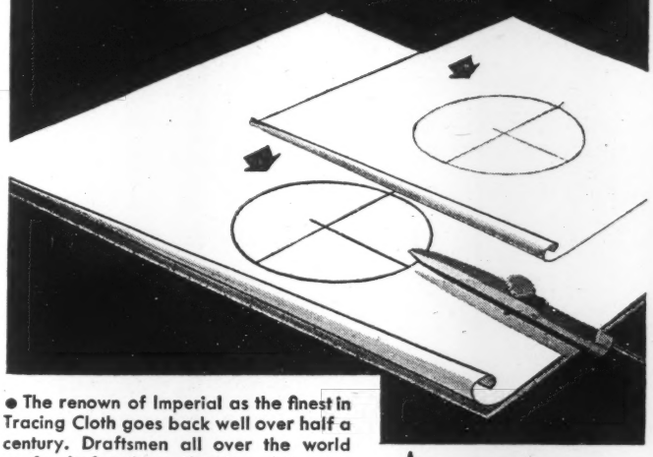
Shafts made to your specifications. Our engineering department will work out your particular power problem without obligation.

Write today for Manual X



F. W. STEWART MFG. CORPORATION
4311-13 RAVENSWOOD AVE. CHICAGO 13, ILL.
WEST COAST BRANCH: 431 Venice Blvd., Los Angeles 15, Cal.

TRACING CLOTH THAT DEFIES TIME



● The renown of Imperial as the finest in Tracing Cloth goes back well over half a century. Draftsmen all over the world prefer it for the uniformity of its high transparency and ink-taking surface and the superb quality of its cloth foundation.

Imperial takes erasures readily, without damage. It gives sharp contrasting prints of even the finest lines. Drawings made on Imperial over fifty years ago are still as good as ever, neither brittle nor opaque.

If you like a duller surface, for clear, hard pencil lines, try Imperial Pencil Tracing Cloth. It is good for ink as well.

IMPERIAL TRACING CLOTH

SOLD BY LEADING STATIONERY AND DRAWING MATERIAL DEALERS EVERYWHERE

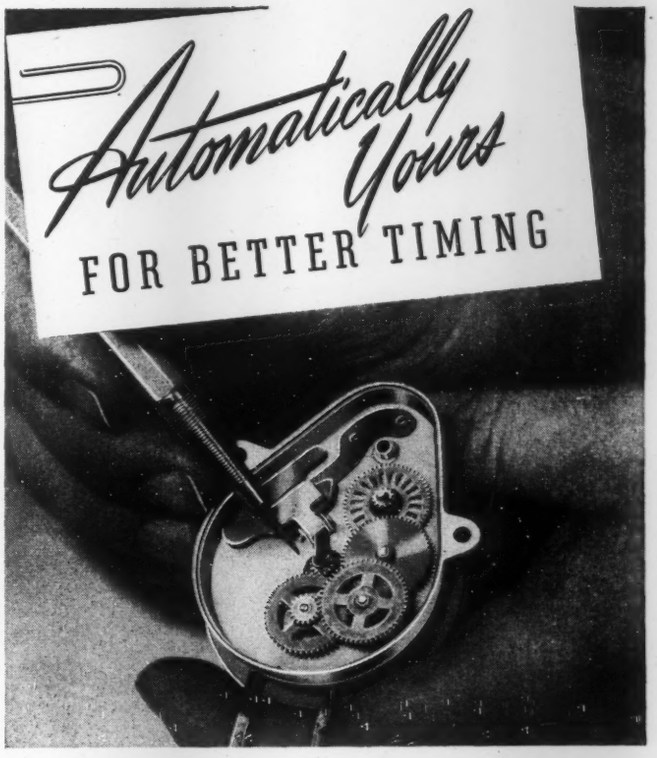
SPEED REDUCERS

Flexible . . . Easy to Mount

The style of reducer shown is built in 12 sizes, which can be assembled for 12 different mounting positions. Flange bases are also available. ¶ These machines can be furnished with specially designed Janette speed reducer motors of from 1/8 to 7 1/2 H.P., with output speeds of 1.89 to 447 R.P.M. ¶ Because of this exceptional flexibility, special mounting adaptors are rarely necessary. **¶ We also build many other styles and sizes of Speed Reducers . . . both Motorless and Motorized . . . for standard and special applications.**

Janette

Janette Manufacturing Co. 556 W. Monroe St. Chicago 6, Ill.



HAYDON Automatic Reset

For applications such as time delay relays, where automatic re-setting is required, HAYDON engineers have built into the #1600 series gear unit a magnetically operated counterbalanced gear shift. This automatically engages and disengages the gear train when the motor field is energized and de-energized. The drive shaft is then reset back to starting position by an external spring. It gives uniform engaging and disengaging action, irrespective of the mounting position of the motor.

● **This construction is available in speeds from 15 RPM down to one revolution in 10 minutes.**

Write for the new HAYDON catalog for detailed description of this and other HAYDON timers.

TIMING ENGINEERING SERVICE

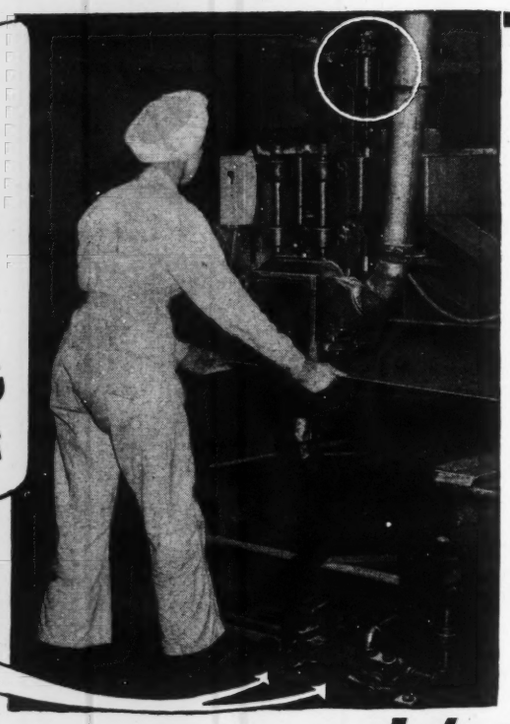
Haydon

MANUFACTURING COMPANY ★ INCORPORATED ★

Forestville, Connecticut

SUBSIDIARY OF GENERAL TIME INSTRUMENTS CORPORATION

FOOT-CONTROL Speeds DEFECT-CUTTING in Veneer Plant



Cutting out surface defects in veneer panels is simplified and accelerated by the use of NOPAK equipment at Pacific Veneer Co., New Westminster, B. C. Here a NOPAK Model E Air Cylinder actuates vertical movement of the veneer cutter. The cylinder is controlled by a NOPAK Model R Foot Valve, leaving the operator's hands free to position the panels quickly and accurately . . . greatly increasing cutting capacity. The other foot valve shown is a NOPAK Model RN, with neutral holding position, which controls a cylinder on an adjacent machine.

GALLAND-HENNING MFG. CO.
2752 S. 31st St. • Milwaukee 7, Wis.

DESIGN ENGINEERS . . .
This application of NOPAK Valves and Cylinders may suggest similar uses for NOPAK Products in machines or equipment which your company manufactures. Write for NOPAK Application Manual.

NOPAK
VALVES AND CYLINDERS
DESIGNED for AIR and HYDRAULIC SERVICE

because they're Forged

. . . and forged **right** by Smith-Armstrong in any of the S.A.E. alloys, high carbon, high chrome, high speed, nitralloy, stainless—or any machine steel giving you the required physicals. Let us quote on your next order.

Smith Armstrong FORGE, INC.
1209 MARQUETTE ROAD CLEVELAND 14, OHIO

Anything Special on Your Mind?

Do you need anything special in the way of thermostats and pressure switches? United has the perfect combination of design and manufacturing experience to fill your needs—at low cost! Hundreds of manufacturers of industrial products have called on us for, and have been satisfied with, this unusual service. See what we have done for others by writing for catalog showing standard and special United controls. Better yet, send us your temperature and pressure control problems for the right, economical solution.

THERMOSTATS & PRESSURE SWITCHES

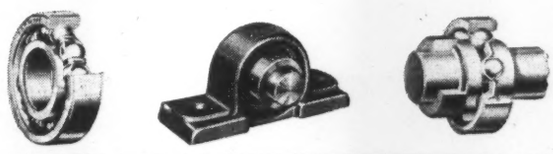
United Electric Controls Company
DEPT. B, 69-71 A STREET, BOSTON 27, MASS.

Now... a slow-speed ball bearing for equipment that needs ball bearing smoothness

● YOU'RE LOOKING at a totally different ball bearing... the Fafnir High-Load Ball Bearing. Unlike standard ball bearings, this new anti-friction bearing is not designed to handle the terrific speeds of spinning shafts. Instead, its purpose is to smooth out the action of oscillating and rolling assemblies. It's made to take more pounds of weight, size for size, than the usual ball bearing. Not only weight but abuse, dirt and moisture.

It's lighter than other bearings but you don't see the real difference till you take off the patented Plya-Seals. The space between inner and outer races is packed with hardened steel balls. No separators. That's the full ball complement for greater weight sustaining and smooth action. All exposed surfaces are cadmium plated or of corrosion resisting material. The PLYA-SEAL keeps in lubricant, locks out dirt and moisture. Made to inch instead of metric dimensions. Bores fit standard bolt sizes.

The Fafnir High-Load offers alert manufacturers ball bearing smoothness where ball bearings were never used before... because it can be smaller, requires no maintenance and is so easily installed and removed. Now adding new smoothness and accuracy to such equipment as business machines, photographic apparatus, printing presses, paper making machinery, dental and medical equipment and farm machinery. Possibly there's an oscillating or rolling assembly in your new design that you could make a winning feature by giving it Fafnir Ball Bearing smoothness. Send blue prints or write for full information. The Fafnir Bearing Company, New Britain, Conn.



FAFNIR BALL BEARINGS

To Start · Stop Indicate · Regulate Distant Motion

Mall REG. U.S. PAT. OFF. REMOTE CONTROL FLEXIBLE SHAFTING

Where quick, positive control of distant motions is essential, Mall Remote Control Flexible Shafting offers design engineers many important advantages. It simplifies design, saves engineering effort, reduces installation time, conserves labor, and assures precision control. Additional advantages are found in the metallic and elastic plastic housings that insulate the shafting against temperature changes, dampness, dust and corrosion.

Every length of Mall Remote Control Flexible Shafting is designed, engineered and fabricated to fit a specific application such as: opening and closing a skylight or valve . . . regulating a thermostat . . . indicating machine speeds on a tachometer . . . setting hands on a clock and many others where a clockwise or counter-clockwise motion is desired. It can be furnished in almost any length or type with splined, flat, square threaded or other styles of ends made of any desired material.

*Over 25 years of designing, engineering and precision manufacturing experience assures correctness of design and high reliability. Write at once, giving full details of your remote control problem. Our Engineering Staff is at your disposal.

FLEXIBLE SHAFT DIVISION

MALL TOOL COMPANY

7731 South Chicago Ave., Chicago 19, Illinois

★ *25 Years of "Better Tools For Better Work"*

Mall REG. U.S. PAT. OFF. PORTABLE POWER TOOLS

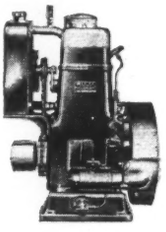
WITTE DIESEL ENGINES

WITTE DIESELECTRIC PLANTS

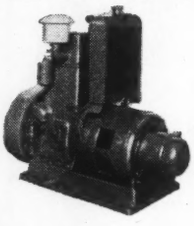
The Finest In American Engineering

Built to build profits for users, year after year. Shipped complete, ready for use.

ENGINE SIZES
4 H.P.
6 H.P.
9 H.P.
12 H.P.



ALL IN CONTINUOUS PRODUCTION—



DIESELECTRIC PLANT SIZES

A. C.	D. C.
3 KVA	2.5 KW
5 KVA	4 KW
7.5 KVA	6 KW
10 KVA	8 KW

There's a reliable WITTE Dieselectric Plant to meet your machine or field needs. Close regulating and constant voltage generators. Write for descriptive literature.

WITTE ENGINE WORKS

DIVISION OF OIL WELL SUPPLY COMPANY — UNITED STATES STEEL CORPORATION SUBSIDIARY

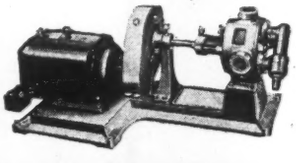
LARGEST BUILDER OF SMALL DIESELS
KANSAS CITY 3, MO., U.S.A.

"We Have Used All Makes . . . FIND VIKINGS the BEST"

In a recent nation-wide survey, users were asked to comment on rotary pumps in use. Many fine compliments concerning the simplicity, ruggedness and dependability of Viking Rotary Pumps were received.

"Vikings extremely satisfactory on heavy work", one user reported. "Of all the pumps we have (and there are a great many) we like Vikings best", another said. "Viking is the best pump for our service. Buy nothing else", still another said. "Vikings do a wonderful job. Don't know what we would do without them", another said.

For complete information on Viking Rotary Pumps, write today for Bulletin Series 46SH. It will be sent free by return mail.



VIKING PUMP COMPANY

CEDAR FALLS, IOWA

See Our Catalog In SWEETS

If it's a Forging— See Billings

Our hammers talk production! . . . Our forging engineers know forgings! . . .

On that forged part "See Billings"

No. 8

WRITE OUR FORGING DIV.

Creative or Production . . . Billings Forging Designers and Production Engineers are available for consultation . . .

THE BILLINGS & SPENCER CO.
MAIN OFFICE AND PLANT
HARTFORD 1, CONN. U. S. A.

Specify Visible Automatic TRICO OILERS

With them you get . . .

Safe, high-speed operation . . .

Bearings get correct amount of oil—not too much . . . not too little. No guess-work—supply is always visible. Reduces fire and accident hazards.

Maximum machine life

Efficient, trouble-free lubrication saves stress and wear on your equipment. Machines last longer . . . give maximum production.

Oil, Power and Time Savings

Correct, adjustable feed saves oil. Correct lubrication insures delivery of rated power. Large reservoir capacity eliminates frequent refilling . . . cuts labor costs.

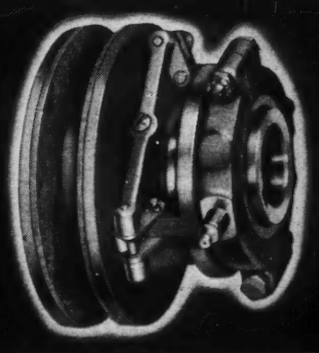
Customer Satisfaction

TRICO Visible, Automatic OILERS on your machines offer plus values that are a sure bet for increased customer satisfaction. Modern, streamlined . . . and there's a style and size for every application.

TRICO **Write for Catalog**

TRICO FUSE MFG. CO., Milwaukee, Wis.
In Canada: IRVING SMITH LIMITED, Montreal

ROCKFORD



LIGHT OVER-CENTER CLUTCHES

COMPACT DESIGN
POWERFUL PULL
SMOOTH ENGAGEMENT
UNIFORM PRESSURE
FINE ADJUSTMENT *
ACCURATE BALANCE
LONG SERVICE LIFE

*Fine adjustment of ROCKFORD Light Over-Center CLUTCHES is accomplished by loosening a conveniently located Locking Screw and turning the threaded, forged-steel Adjusting Plate which carries the operating linkage.

Send for This Handy Bulletin

Shows typical installations of ROCKFORD CLUTCHES and POWER TAKE-OFFS. Contains diagrams of unique applications. Furnishes capacity tables, dimensions and complete specifications.

ROCKFORD CLUTCH DIVISION BORG-WARNER
311 Catherine Street, Rockford, Illinois, U. S. A.

Millions of 'em

B-G-R springs spark the life of industry—business—home. There are good reasons for their choice in all types of mechanisms—simple or precision.

B-G-R springs deliver every ounce of performance you specify—plus. They are uniform, held to size and shape by engineering and laboratory controls in every phase of operation.

Next time you need springs, ask B-G-R to custom-build them to your needs. You'll like the results.

SPRINGS
Wire Forms
Small Stampings

BARNES-GIBSON-RAYMOND

BGR

DIVISION OF
ASSOCIATED SPRING CORPORATION

TWO PLANTS FOR SPRING SERVICE

DETROIT 11, MICHIGAN
ANN ARBOR, MICHIGAN

DRILL JIG BUSHINGS

Accurate
Interchangeable
Concentric

Acme
Industrial
Company

WRITE FOR FREE CATALOG

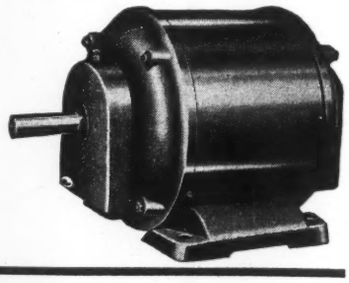
211 N. LAFLIN STREET, CHICAGO 7, ILLINOIS

Design Engineers Specify

VALLEY
Ball Bearing
MOTORS

Because—

- They offer more flexibility in power planning.
- They are built to meet unusual power loads and high temperatures.
- They meet all operating conditions where hazards of liquids, chips, etc., dropping into the motor are involved; as well as splash conditions.
- Being made in ½ to 75 h. p. sizes, they offer wide adaptability.



Valley ELECTRIC

VALLEY
ELECTRIC CORPORATION
4221 Forest Park Blvd. • St. Louis 8, Missouri

What jobs have you for CARMET to do?

Special Blanks made from CARMET CARBIDES

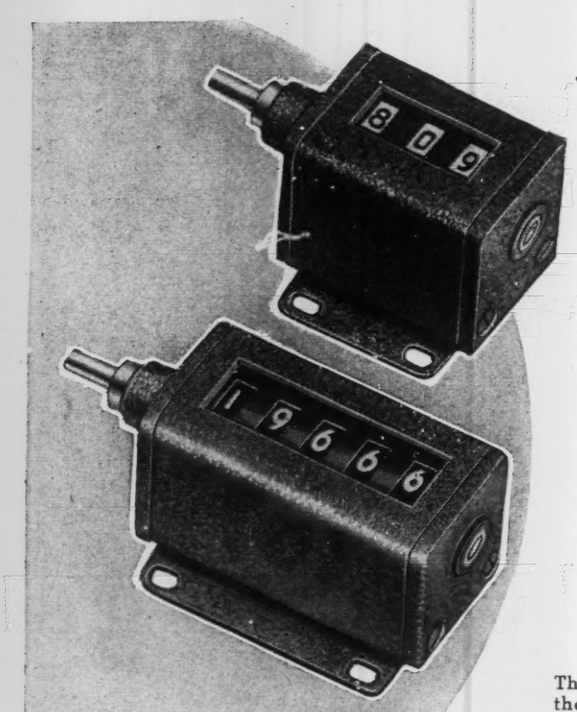
Take a look, above, at a few of the many preforming jobs we do with Carmet—then tell us where we can help *you* to utilize the great wear-resistance of sintered carbides. The point is: we have an entirely complete line of Carmet carbide cutting tools and blanks, but we also specialize in preformed carbide machine parts of practically any size and shape—gage blanks, bushings, die parts, etc.—furnished either "as formed" or finish-ground to exacting tolerances. ● Let us work with you—*call for an Allegheny Ludlum Tool Engineer.*

ADDRESS DEPT. MD-38

Allegheny Ludlum Steel Corporation

CARBIDE ALLOYS DIVISION, Ferndale (Detroit) Michigan

W&D—624



Announcing...

the new "Y" Series

PRODUCTIMETERS

To the growing line of Productimeter counting and measuring machines, we are proud to add a small, non-reset rotary counter, designated as the "Y" model . . . extremely light of operation . . . especially constructed for high speeds . . . available in three to eight figures capacity.

"Y" units are particularly adapted for incorporation as integral parts of machinery . . . office appliances, laboratory equipment, meters, voting machines and electronic devices.

Send for complete information!

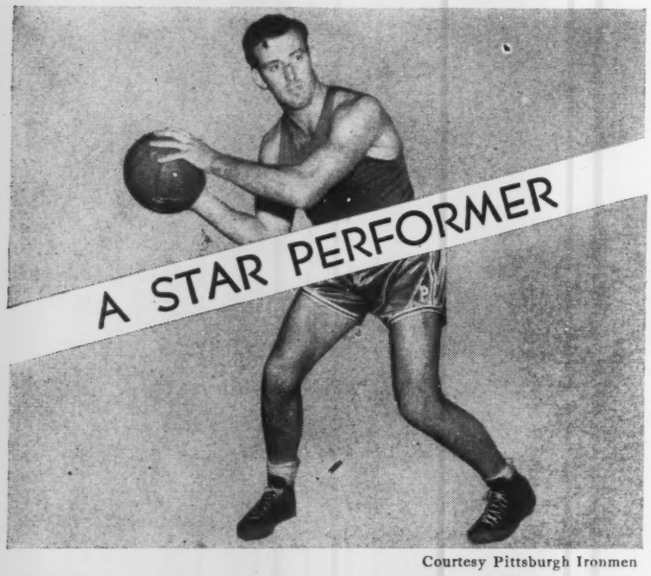
There's a Productimeter for practically every purpose and application, from these small "Y" models to large, heavy duty counters . . . Stroke, Rotary, Lineal, Predetermined and Electric.

DURANT MANUFACTURING COMPANY

1933 N. Buffum St.
MILWAUKEE 1, WIS.

●

133 Orange St.
PROVIDENCE 3, R. I.



Courtesy Pittsburgh Ironmen

Elliott's LIN-O-BLU *Paper*

NONE LIKE IT. . . . FOR DIRECT BLUE LINE PRINTS

★ No. 10 *Sharp and Permanent*

Elliott's LIN-O-BLU Ammonia developed paper should be used by you IT is a STAR PERFORMER everytime. Available in thin, medium or heavy weights. WRITE DEPT. U-5 FOR FREE SAMPLES

B. K. ELLIOTT CO.

MANUFACTURERS OF REPRODUCTION PAPERS

PITTSBURGH — DETROIT — CLEVELAND

WHEELS *by French & Hecht*

ENGINEERED DEPENDABILITY

For the safe and efficient mobility of your product—implements, conveyances, portable equipment — rely upon the specialized engineering and production competence of this organization. STANDARDIZATION — Perhaps we can recommend STANDARD WHEELS and HUBS to meet your requirements — thereby eliminating undue delays.

also
HUBS
AXLES
and
SPECIAL PRODUCTS

for FARM and INDUSTRY

Send us Your Wheel Problems

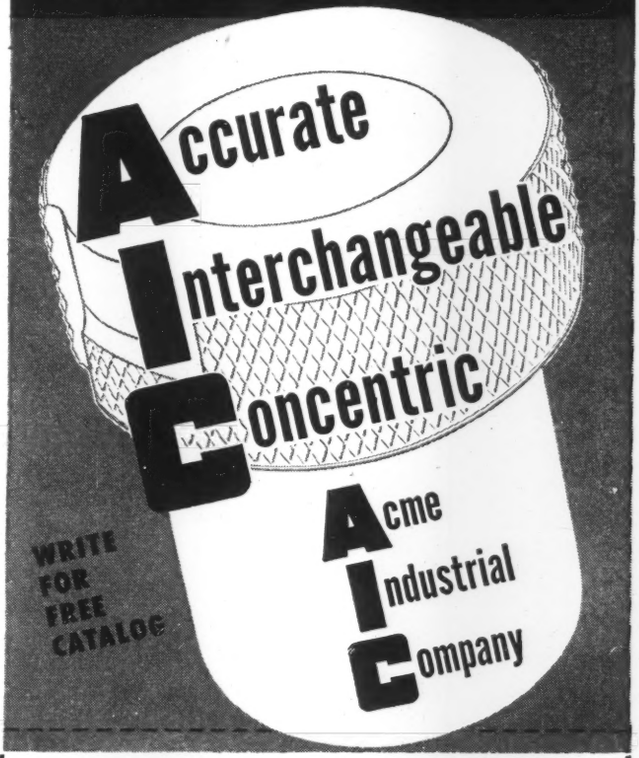
FRENCH & HECHT

DIVISION KELSEY-HAYES WHEEL COMPANY

DAVENPORT, IOWA

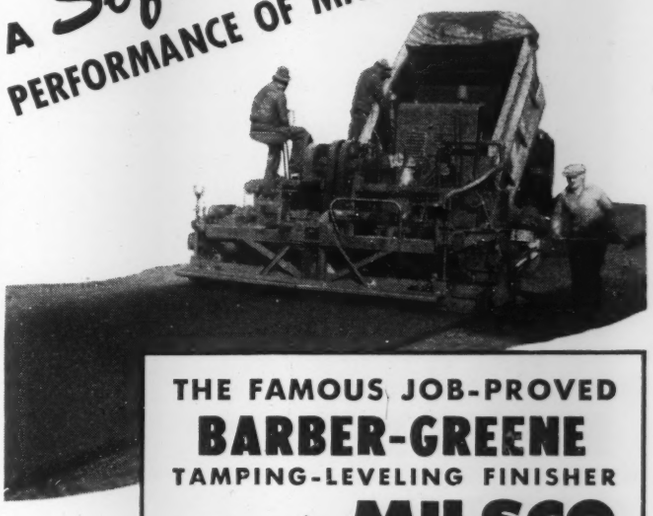
Wheel Builders Since 1888

DRILL JIG BUSHINGS



211 N. LAFLIN STREET, CHICAGO 7, ILLINOIS

A *Soft Ride . . . Ups*
PERFORMANCE OF MAN AND MACHINE



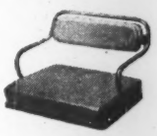
THE FAMOUS JOB-PROVED
BARBER-GREENE
TAMPING-LEVELING FINISHER
is another **MILSCO**
Engineered Cushion Seat Installation

The job-proved BARBER-GREENE Tamping-Leveling Finisher, made by Barber-Greene Company, Aurora, Illinois, is equipped with "seat comfort" (MILSCO Leather Covered Cushion Seat, Number 713) that provides the highest degree of *operator job-response.*

Men of MILSCO are *specialists* who devote their time and talents to designing and engineering "seat comfort" into heavy-duty mobile equipment. They approach a seat problem with the knowledge, backed by experience, that machine efficiency is inseparably linked to *operator comfort;* that freedom from "Seat-Fag" helps to keep the operator's performance at its peak which, in turn, is translated into increased machine output.

Whatever your seat problem, MILSCO specialists can solve it with a soft, comfortable seat suited exactly to your machine and your cost requirements. Write for details.

STANDARDIZED TYPES


MILSCO
Commander Type

MILSCO
Crusader Type

Milsco
MILWAUKEE

MILSCO
Utility Type

MILSCO
Semi-Bucket Type

MILSCO
Bucket Type
with backrest

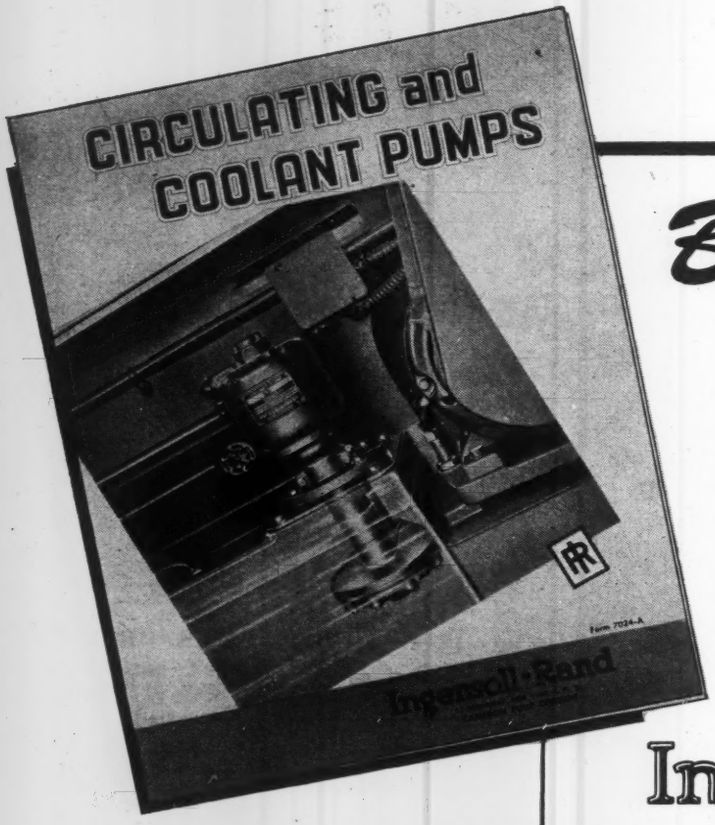
MILSCO MANUFACTURING COMPANY
2758-C NORTH 33RD STREET, MILWAUKEE 10, WISCONSIN

Speed Reducers FROM STOCK

Manufactured in a practical range of sizes and reductions. We also build reducers to meet special needs.

CALL US
LONG DISTANCE

Eberhardt-Denver Co.
GEARS AND SPEED REDUCERS
1416 West Colfax Ave., Denver 4, Colorado Phone TAbor 7134



Before you install a new machine tool . . . .

or before you replace the pump on your existing machine, investigate the Ingersoll-Rand line of circulating and coolant pumps. These units have been developed especially for handling coolant and cutting fluid on machine tools.

Form 7024-A, illustrated above, is filled with pertinent information including dimensions and performance on these pumps. Write for your copy today.

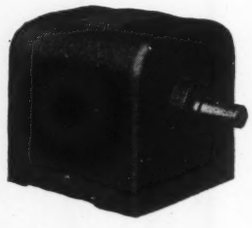
Ingersoll-Rand

11 Broadway, New York 4, N. Y. 9-798

WRITE FOR BULLETIN

DETROIT Bevel Gear COMPANY
8130 JOS. CAMPAU AVE. DETROIT 11, MICH.

SPEED UP YOUR OPERATIONS



WITH TYPE PR CENTRIFUGAL SWITCHES

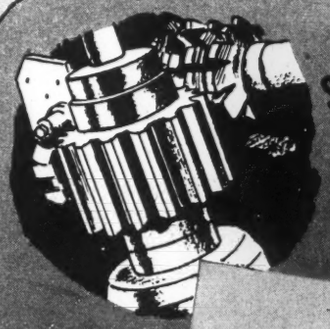
Machine tools used in repetitive cycles produce more when equipped with Euclid Centrifugal Plugging Switches. These switches plug motors to a quick stop at the end of each cycle by applying reverse power until the motors reach nearly zero speed, thus cutting down the non-productive time between cycles.

They also make the machinery safer by stopping the motors quickly in case of an emergency.

Write for Bulletin 1001-MD

THE EUCLID ELECTRIC & MFG. CO.
1335 CHARDON RD. EUCLID 17, OHIO

YOU SAVE 3 WAYS WITH GRAMIX IRON GEARS



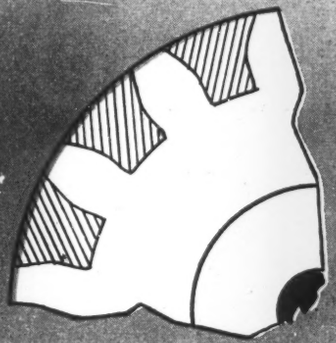
SAVE MACHINING TIME

Small iron gears made of Gramix are formed individually in one quick operation —teeth, keyway, chamfered edges and all—with just one powerful stroke of a mechanical press. Subsequently the gears are sintered and sized to exact finished dimensions.

SAVE LABOR COSTS

Gramix gears are made by die-forming powdered iron and other metals under high pressures. They are rigidly held to close tolerances and finished with fine, smooth surfaces that require no machining, hobbing, broaching or shaving operations.

SAVE MATERIALS



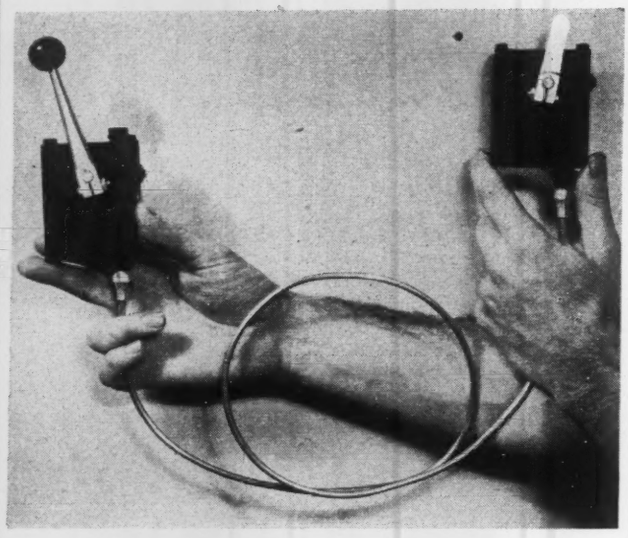
Because there is no machining, there is no costly scrap remaining from the manufacture of Gramix gears—you get more parts per ton of metal. And, Gramix gears may be made with desired porosity to permit impregnation with a lubricant, thus creating an oil reservoir that lubricates each gear tooth at all times.

Send us drawings or descriptions of your products so our engineers may make recommendations where strong, self-lubricating, low-cost Gramix gears, bearings, washers, and other parts may improve mechanical performance and save you money.

THE UNITED STATES GRAPHITE COMPANY • SAGINAW, MICHIGAN

HYDRAULIC *REMOTE* CONTROL

WATER-PROOF . . . CORROSION-RESISTANT . . . DUST-PROOF



"Single-Tube" Systems
Dependable
Accurate
Easily Installed

The newest Sperry Product for finger-tip control!

The Type HCO1-B Sperry Control is an almost miniature hydraulic remote control which retains all the features of larger units long manufactured by Sperry. *Balance* gives finger-tip operation and freedom from time-lag and back-lash. A synchronizing valve compensates for volumetric variations of the fluid.

ADVANTAGES OF HYDRAULICS

Hydraulics means the elimination of link rods and bell cranks, of pulleys and control cables, and of the design limitations that their use entails. Sperry's remote control system uses a transmitter and a receiver connected by a *single* copper tube that can be bent to go around, or through, or over obstructions.

For complete information and specifications write for Bulletin A-2400. Dealer inquiries are also welcomed.

SPERRY

SPERRY PRODUCTS Inc.
1505 Willow Avenue
Hoboken, N. J.

The Bear Model 340 balancing an armature

One new-product advancement that everybody will welcome is dy-namic balance of its rotating parts—and your forthcoming products can have that improvement easily, quickly, economically, with the versatile Bear Static and Dy-Namic Balancer No. 340.

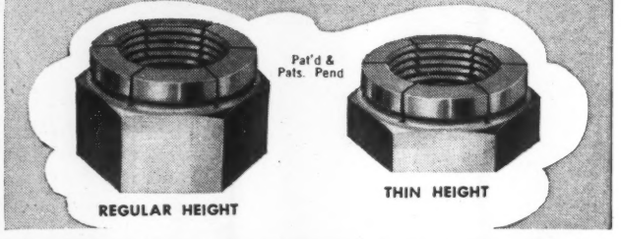
This bench model handles the majority of balancing work found in general manufacturing. In a few minutes it statically and dy-namically balances bodies to any recognized standard. It takes little space. Any shop hand learns to use it in four hours. And the Model 340 is very reasonably priced because it is a simple machine, built to a direct, simple principle.

Put the "performance plus" of Bear-balancing into your coming products! Send for the new 340 literature! BEAR MFG. CO., Dept. M4, Rock Island, Illinois

1621

BEAR
COMBINATION
STATIC AND DY-NAMIC BALANCING MACHINES

FLEXLOC



SELF-LOCKING NUTS

CAN YOU BE SURE THAT A PLAIN NUT WON'T SLYLY UNWIND ITSELF? If not, then what you need is the All-metal, One-piece "Flexloc," which is a self-Locking Nut that won't budge, except when a wrench is used.

"Flexloc" packs maximum usefulness in minimum space because it is rugged, locked, compact—and is therefore, becoming increasingly popular and this applies alike to U.S.S. and S.A.E. thread series. Every thread—including the locking threads—takes its share of the load.

Covers a wide range of tolerances—from low #1 to high #3. Can be used over and over again without losing much of its locking ability.

Being a "stop" nut, it stays locked in any position on a threaded member.

"Flexloc" Thin Nuts are especially popular, because their tensile is so high.

Sizes from #6 to 1" in diameter—millions in use!

Convince yourself with a few free samples

OVER 43 YEARS IN BUSINESS

STANDARD PRESSED STEEL CO.
JENKINTOWN, PA., BOX 102
BOSTON • CHICAGO • DETROIT • INDIANAPOLIS • ST. LOUIS • SAN FRANCISCO

AVAILABLE NOW! by The Million!

GASKETS

Made of

Prompt Deliveries, to hundreds of manufacturers who require gaskets in the production of their products, is more than a promise, at Fel-Pro. For, in our plants, we have the facilities to produce the **type** of gaskets you want, in the **quantities** you need, at **the time** you want them.

If your product requires some special, different kind of gasket, put the problem up to the specialized knowledge and experience of Fel-Pro's Engineering Department. Many of the largest manufacturers are Fel-Pro customers. **FOR YOUR FREE FOLIO** containing 53 actual samples of materials suitable for Gaskets, Packing, Insulating, Dampening and Sealing, write today to the

INDUSTRIAL GASKETS AND PACKING DIVISION OF FELT PRODUCTS MFG. CO., 1517 Carroll Ave., Chicago 7, Ill.

ASBESTOS

PAPER

NEOPRENE

RUBBER

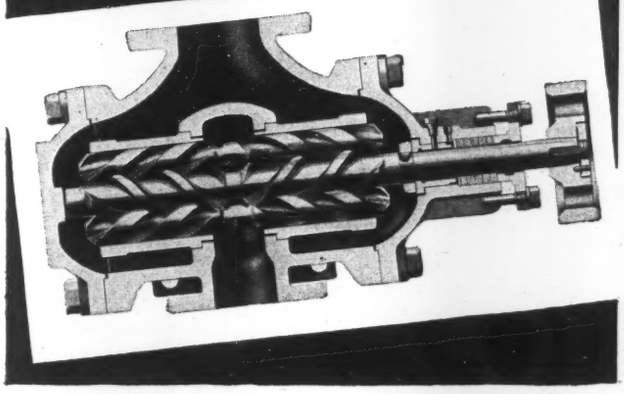
and many other materials

FEL-PRO

for ORIGINAL EQUIPMENT requirements

2096

NO GEARS



The IMO PUMP requires no gears, because the fluid pumped is propelled from suction to discharge by the action of three intermeshing rotors. That's all there is to it—no gears, valves, vanes or pistons!

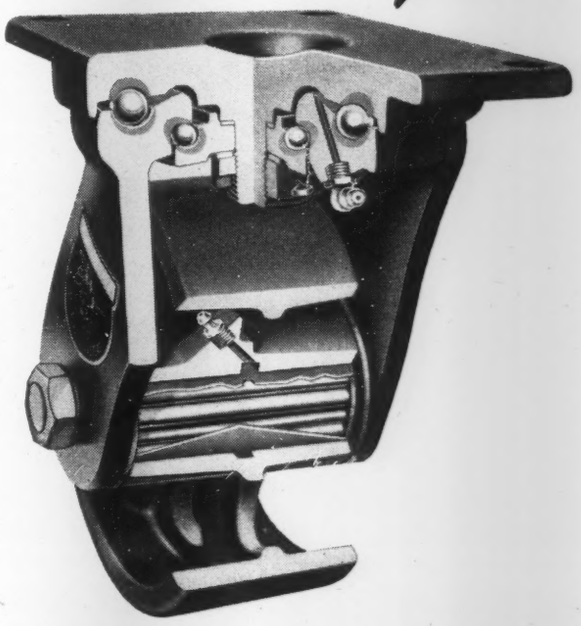
For simplicity, reliability and compactness select the IMO—for use in hydraulic service, governor service, lubrication service and other fluid handling services.

For further information send for catalog I-132

IMO PUMP DIVISION of the DE LAVAL STEAM TURBINE CO. TRENTON 2, NEW JERSEY

RAPIDS-STANDARD CASTERS

STEEL-FORGED FOR *Strength*



FLAME-HARDENED FOR

LONG-*Wear*

Rapids-Standard Casters are made of drop-forged SAE 1045 steel for maximum strength and greatest overload capacity. Under the toughest running conditions — shock loads, continuous operation, constant overloading — these tough casters will continue to roll easily and smoothly.

The swivel bearing ball races are flame hardened to combine extreme hardness at contact points with tough shock resistance in the caster body. As a result, Rapids-Standard Casters continue to swivel smoothly and run without wobble long after other casters have been replaced.

Rapids-Standard casters come in both rigid and swivel types with a choice of bearing depending upon the service for which they are intended. Wheel types include Nicro-Steel, Forged Steel, Resinoid and Rubber. Rapids-Standard offers a bearing and wheel combination to exactly suit your application in a capacity for any type of industrial application.

The new Rapids-Standard Caster Catalog is now ready. It contains complete specifications on sizes, types, capacities together with suggestions for more efficient caster use. Write for your copy today.

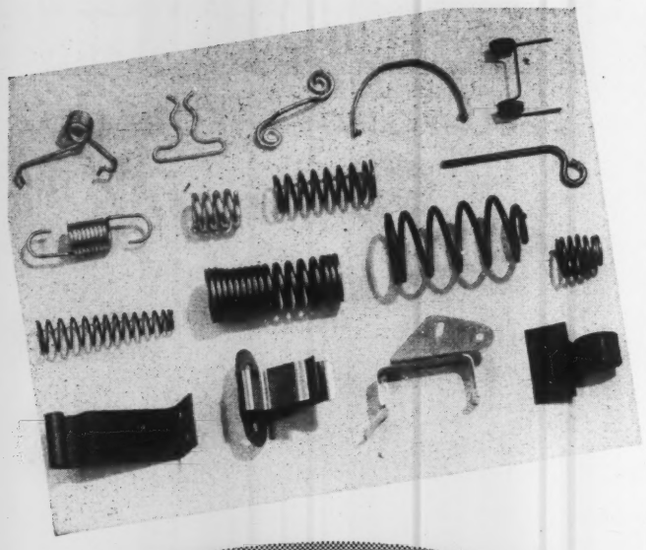
OFFICES IN PRINCIPAL CITIES

Manufacturers of

STEEL FORGED CASTERS · TRUCKS & CONVEYORS · POWER BOOSTERS

The Rapids-Standard Co., Inc.

Sales Div.—330 Peoples Nat'l Bank Bldg., Grand Rapids 2, Mich.



SPRING Performance Always Outweighs Spring Prices!

In buying springs, *values* and *prices* are two quite different things. On your spring purchases, do not be penny wise and pound foolish, for in the end cheap springs are seldom economical. What does a spring cost if it *fails?* The reputation of the spring manufacturer is the one true and final guarantee of quality. A spring which will *pass inspection* requires relatively little skill, but building a spring which will indefinitely perform a given function is a genuine art. You may take it as a maxim that you can always find a lower price. But with springs, perhaps more than with any other component part, you never get a higher degree of *performance* than you actually pay for.

At Reliable, spring experts in every department are thoroughly schooled to give you the TOP spring for the purpose, at the LOWEST cost at which anybody can furnish you that kind of spring.

Send for latest Reliable Bulletins.

THE RELIABLE SPRING & WIRE FORMS CO.
3167 Fulton Road **Cleveland 9, Ohio**

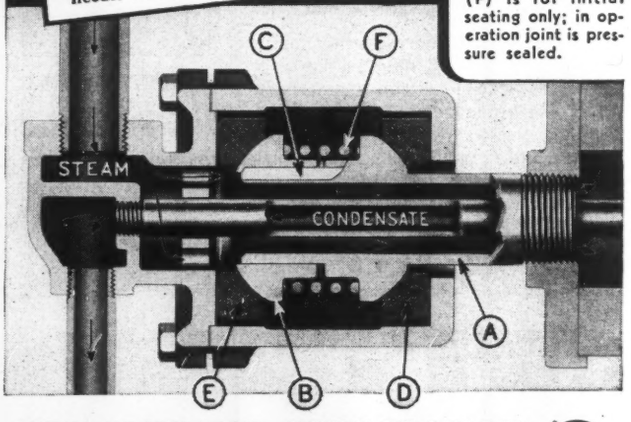
Representatives in Principal Cities

YOU CAN RELY ON **Reliable Springs**
ROUND AND FLAT WIRE SPRINGS · CLIPS · HOOKS · BENDS · LIGHT STAMPINGS

GOT A JOB FOR JOHNSON JOINTS ?

You have if you're faced with a problem that involves getting steam or liquids into rotating machine parts. The Johnson Rotary Pressure Joint is completely packless, self-oiling, self-adjusting, and even self-aligning. Industry has already put 100,000 to work, in barely ten years. Type B shown provides for condensate removal; other types and sizes for all needs. Write for details.

Nipple (A) connected to roll or drum. Sliding collar (B) keyed (C) to nipple. Carbon - graphite seal ring (D) and bearing ring (E) eliminate oiling and packing. Spring (F) is for initial seating only; in operation joint is pressure sealed.



THE JOHNSON CORPORATION
811 Wood St., Three Rivers, Michigan

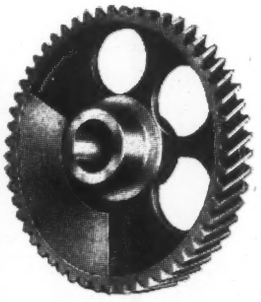
SHAVED *Gears* . . . for accuracy and efficient performance

- ★ SPUR
- ★ BEVEL
- ★ HELICAL
- ★ SPLINE
- ★ WORM
- ★ SPECIAL

The Cincinnati Gear Company, in keeping with its policy of making GEARS, GOOD GEARS ONLY, extends to you the facilities of its modern and completely equipped plant.

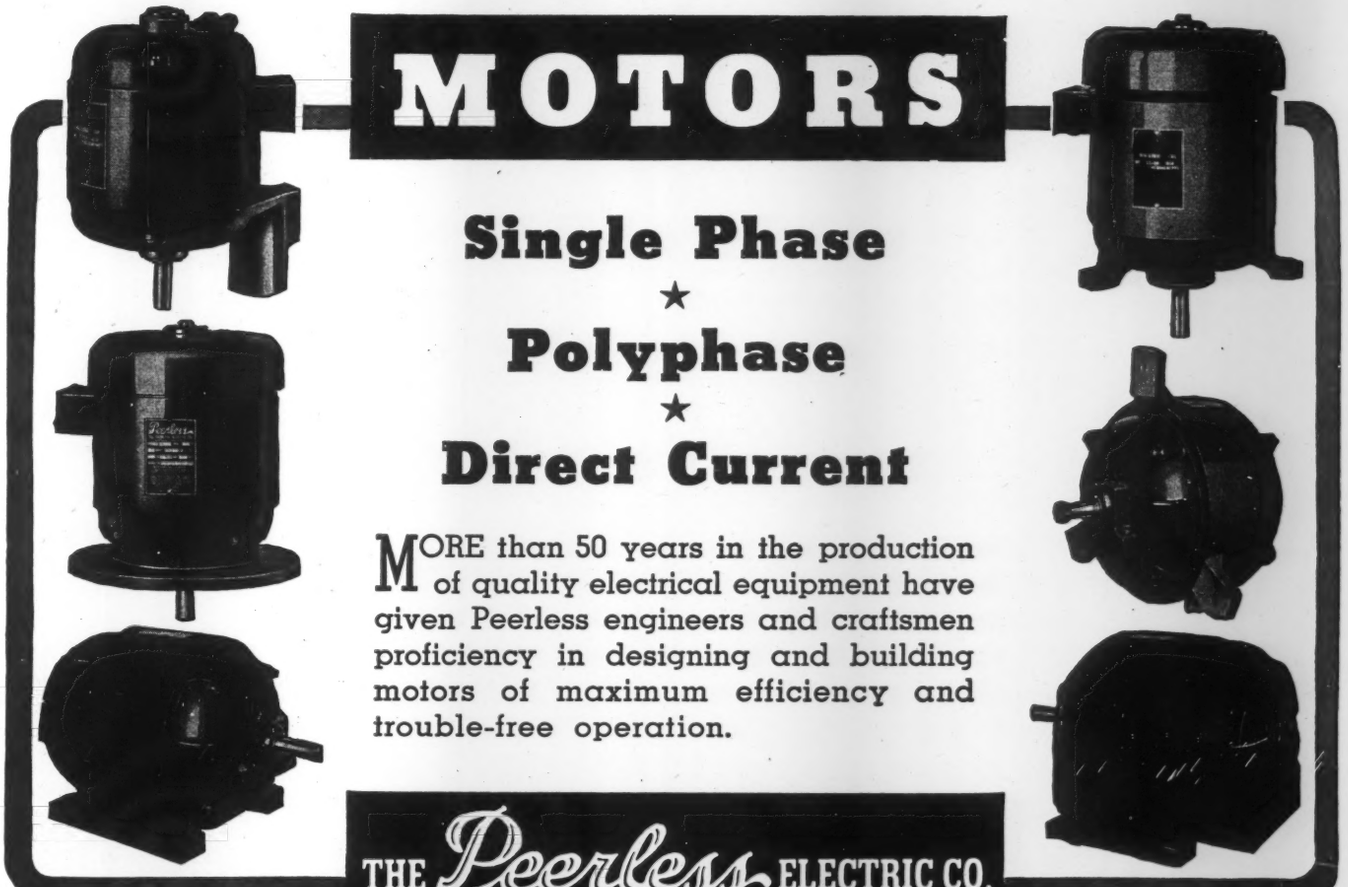
For example:

To provide the maximum in gear efficiency each CINCINNATI GEAR, where needed, is shaved. We are equipped to handle shaved gears up to 24-inch pitch diameter (maximum). Accuracy is held to within .0002" tooth-to-tooth spacing and .0005" for any two teeth . . . involute is within .0002".



Where performance must be right, specify Cincinnati *Gears, Good Gears Only.*

THE CINCINNATI GEAR COMPANY
"Gears . . . Good Gears Only"
Wooster Pike and Mariemont Ave. ★ Cincinnati 27, Ohio



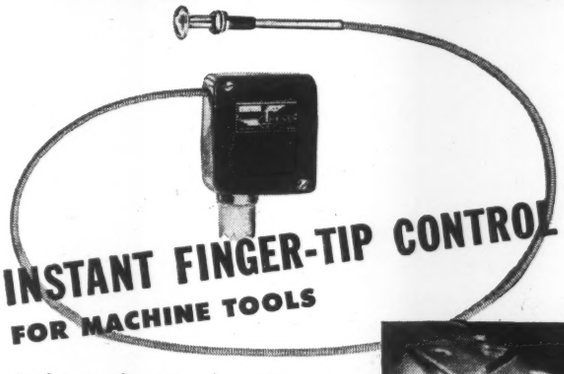
MOTORS

Single Phase
★
Polyphase
★
Direct Current

MORE than 50 years in the production of quality electrical equipment have given Peerless engineers and craftsmen proficiency in designing and building motors of maximum efficiency and trouble-free operation.

THE *Peerless* ELECTRIC CO.
WARREN, OHIO

REMOTE SWITCH CONTROL



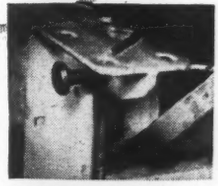
INSTANT FINGER-TIP CONTROL
FOR MACHINE TOOLS

Here's the new low-cost Arens Remote Switch Control which provides instant starting and stopping for machine tools without rewiring. It also reduces machine tool installation costs and provides greater safety.

The control head may be quickly mounted on the machine at the point most convenient for the operator. The flexible cable can then be carried to the switch box which may be located either adjacent to the motor or convenient to present wiring or junction box.

If desired the control head may be mounted so the operator with body pressure against the switch button can turn the machine off.

Write for Bulletin No. 11 Today

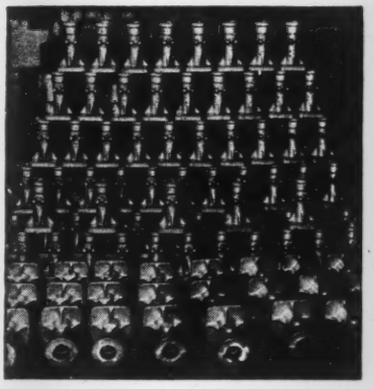


Many Models Available
Standard Models (such as the installation above) as well as special units are available for any type of machine tool operation. This control is also particularly economical for installation on multiple units.

ARENS CONTROLS, INC.
2257 South Halsted Street • Chicago 8, Illinois

1200 of these

CAST BRONZE STANDS



PASSED NAVY INSPECTION
. . . without a rejection

Above: Part of order for 1,200 Cast Stands of HY-TEN-SL Bronze, weight 15 lbs. each, 90,000 T.S., 45,000 Y.P., 20% Elongation; Federal Specs. QQB 726 Grade B.

You are safe in bringing your problems to us: Corrosion Resistance; Strength in Tension and Compression; Hardness and Toughness; Pressure Tightness; Erosion Resistance; Frictional Wear Resistance, or Fatigue Resistance.

Would you like a copy of our famous 42-page flexible-bound Reference Book entitled, "Bronze Casting Alloys"? If so, write us on your business letterhead.

AMERICAN MANGANESE BRONZE COMPANY

4715 Rhawn St., Holmesburg, Philadelphia 36, Pa.
PITTSBURGH, PA. 37 YEARS' EXPERIENCE

When Webbings Go Into Your Products

Specify

Buffalo Brand

Pretested

Webbings

Hidden or in sight, the webbings you use in your products may have a lot to do with their success. Whichever of the following features are most important to you, you'll find them in Buffalo Webbings.

STRENGTH . . . LONG LIFE APPEARANCE

The big reason why Buffalo Webbings are the choice of manufacturers the country over is tighter weaving of batch pretested cotton, nylon, linen and jute yarns. All weaving is done on specially constructed looms to assure smoothness, uniformity and prevent curling.

A RIGHT BUFFALO WEBBING FOR EVERY NEED

Non-stretch webbing, three-leaf webbing, back banding, harvester webbing, sand belting and bolting cloth webbing are just a few of the hundreds of Buffalo Webbings. Write for descriptive folder.

BUFFALO WEAVING AND BELTING CO.

Buffalo 7, N. Y.

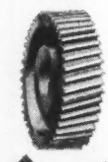
New York Chicago

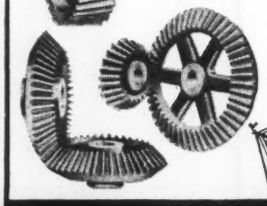
America's Foremost Makers of Webbings

Your **DECISION**

will be influenced by the accuracy, durability and consistant quality of our product. And, when dependable performance is the deciding factor—it's

"Thumbs up" for *Industrial"*





—because "Industrial" gears have what it takes. We deliver the kind of gears, racks and sprockets you specify. Our shop is large—we are specialists—our tool equipment is 95% new. Each machinist in our plant is a craftsman who can set up his own machine. All work passes rigid inspection. You get the best there is!

Decide now to make "Industrial" your source of supply.

Write for catalog and handbook on your company letterhead.

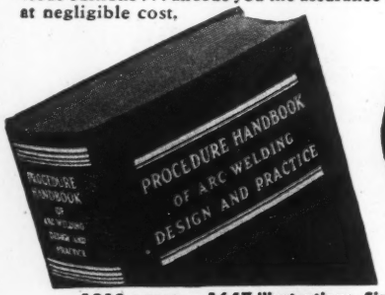
INDUSTRIAL GEAR MFG. CO.

4529 VAN BUREN STREET CHICAGO 24, ILLINOIS

The *New* in Arc Welding ...your guide to LOWER COSTS

NEW EIGHTH EDITION "Procedure Handbook of Arc Welding" gives you the latest information on all phases of this fast-growing process for lower costs and better products. 35 new procedures. 22 new cost tables. 16 new subjects in Arc Welding design, technique, application.

Even if you have previous editions of the "Procedure Handbook", you cannot afford to be without the new, authoritative Eighth Edition. This 1312-page "bible of Arc Welding" outdates all previous editions . . . affords you the assurance of reliable reference data at negligible cost.



ONLY $1.50 Postpaid in U. S. A. $2.00 elsewhere

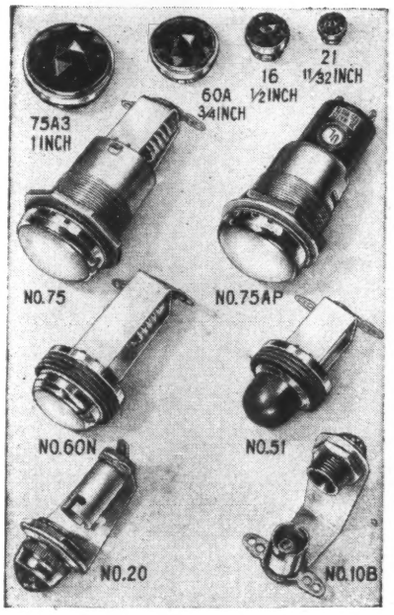
1312 pages...1647 illustrations. Size 6" x 9" x 1¾"

- Welding Methods & Equipment
- Technique of Welding
- Procedures, Speeds & Costs
- Weld Metal & Methods of Testing
- Weldability of Metals
- Machine Design
- Structural Design
- Applications
- Reference Data

Order your Handbook today. Mail order and check to:

MACHINE DESIGN

Book Department • 1213 W. Third St., Cleveland 13, Ohio



WHAT TYPE OF *Jewel Assembly* DO YOU NEED?

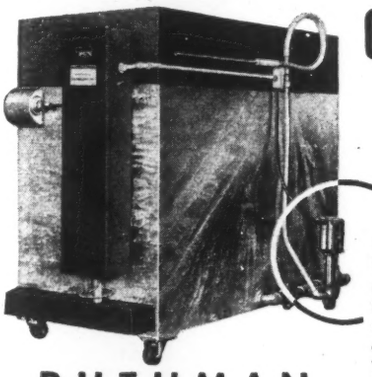
No matter what type or size of Jewel Light Assembly you need, chances are we can produce it for you quickly, more satisfactorily, *and at lower cost!* Here, every facility is available for high speed quantity production . . . speedy, efficient, economical service. Drake *patented features* add greatly to the value and dependability of our products.

You'll like the friendly, intelligent cooperation of our engineers. Let them help you with signal or illumination problems. Suggestions, sketches, cost estimates or asking for our newest catalog incur no obligation.

DRAKE

DRAKE MANUFACTURING CO.
1713 W. HUBBARD ST., CHICAGO 22, ILL.

What do You want in a . . .



COOLANT PUMP?

Illustrated above is an installation of a *Ruthman Model 4-P3 Long* on a *Phillips All Electric Vapor Degreaser Model 60.* On this installation the *Gusher Pump* performs three pumping operations from a central solvent sump which is divided into a clean and dirty solvent sump. The *Gusher Pump* furnishes clean solvent to the flushing spray hose—pumps clean solvent from the clean solvent sump to the boiling sump—and also pumps out both sumps to drain the machine for cleaning.

RUTHMAN GUSHER COOLANT PUMPS

This is another example of the versatility of *Ruthman Gusher Coolant Pumps.* Our long experience in designing and manufacturing pumps assures you of the correct design to meet your requirements efficiently and economically.

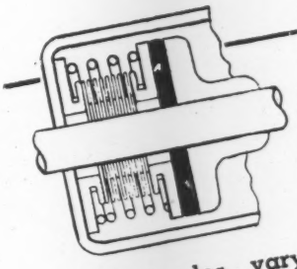
We will be glad to advise you on your requirements both in a standard model pump or a pump for specialized requirements.

Write for Catalog 10C

THE RUTHMAN MACHINERY CO.

1811 Reading Road Cincinnati, Ohio

CARBON SEAL RINGS

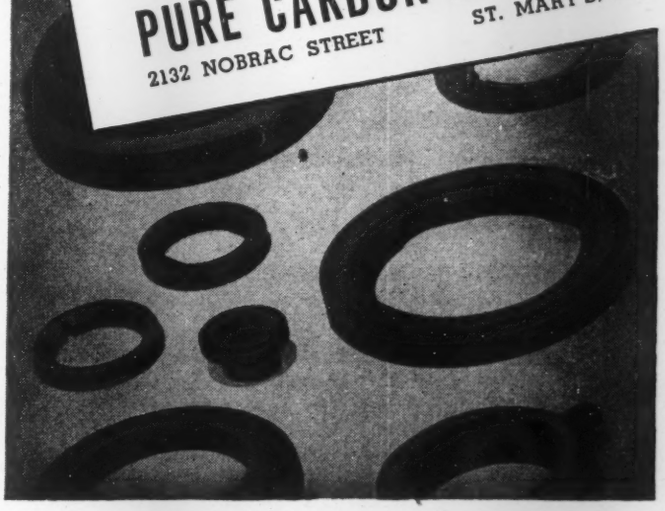


Pure Carbon Seal Rings are supplied in over 20 different grades. These grades vary in porosity from slightly porous materials for use in oil, water and grease seals to highly impervious material for sealing gases and liquids at high pressures.

Our Bulletin No. 461 describes these grades in detail giving specific recommendations for all types of service.

Write today for Bulletin 461

PURE CARBON CO., INC.
2132 NOBRAC STREET ST. MARY'S, PA.



It Costs You Less To Pay a Little More For SILLCOCKS-MILLER PLASTIC NAME PLATES

The nameplate that identifies your product should reflect the quality you build into it.

Recognizing this, manufacturers all over the country have made Sillcocks-Miller their source for nameplates fabricated of plastic. These companies know that quality is a tradition here at Sillcocks-Miller . . . that every job must conform to our rigid standards of accuracy and perfection.

From long experience, our engineers can readily meet your nameplate requirements. There is no lost motion, no delays to you because of "trial and error" production.

That's what we mean when we say it costs you *less* to pay a little more for Sillcocks-Miller quality.

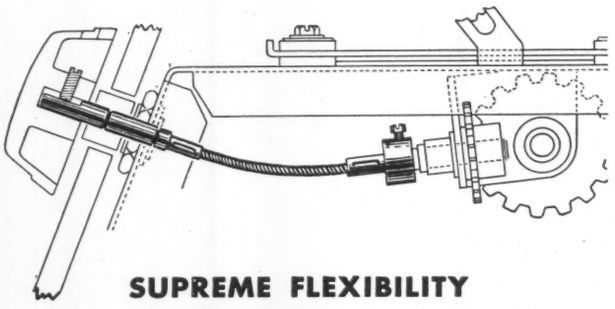
Write for complete details

THE SILLCOCKS-MILLER CO.

10 West Parker Avenue, Maplewood, N. J.
Mailing Address: South Orange, N. J.

SPECIALISTS IN HIGH QUALITY, PRECISION-MADE PLASTICS FABRICATED FOR COMMERCIAL, TECHNICAL AND INDUSTRIAL REQUIREMENTS.

REMOTE CONTROL
BY ELLIOTT



SUPREME FLEXIBILITY FOR EFFORTLESS OPERATION

APPLICATION ILLUSTRATED COURTESY OF R C A VICTOR

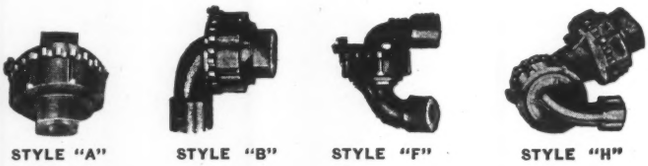
Let Elliott design, engineering and production facilities solve your Flexible Shaft problems, whether it be radio or heavy duty controls. Send specifications for our recommendations and our prices.

OTHER ELLIOTT PRODUCTS: MONOCOIL — helically wound wire for push-pull or small Flexible Shaft casings. PUSH-PULL CONTROLS for radio, auto, aircraft and industry. STAINLESS STEEL and PHOSPHOR BRONZE FLEXIBLE Shafts for corrosion resistance. FLEXIBLE SHAFT ASSEMBLIES of all types for power drives and remote controls.

ESTABLISHED 1935
ELLIOTT MANUFACTURING COMPANY
217 PROSPECT AVENUE • • • • • BINGHAMTON • NEW YORK
★ FLEXIBLE SHAFTS FOR POWER TAKE-OFFS AND REMOTE CONTROLS ★

CHECK THESE FLEXO JOINT FEATURES

- √ Unrestricted Flow
- √ Strength of Pipe
- √ Flexibility of Hose
- √ Longlasting Service
- √ Low Maintenance Cost
- √ No Complicated Parts
- √ No Ground Surfaces to Wear



STYLE "A" STYLE "B" STYLE "F" STYLE "H"

Wherever a flexible or swing pipe joints are required to convey steam, compressed air, gas, water, oil, or other liquids, specify Flexo Joints for dependability and constant service.

Simply and ruggedly constructed with full protection from dirt and grit. Flexo Joints work smoothly at all times—no binding. No restrictions in the flow of fluid at any time—in any position. Nominal first cost.

These are just a few of the features that make Flexo Joints outstanding . . . . they are giving dependable service in plants all over the world. Pipe sizes from ¼ inch to 3 inches.

Write for descriptive literature and data

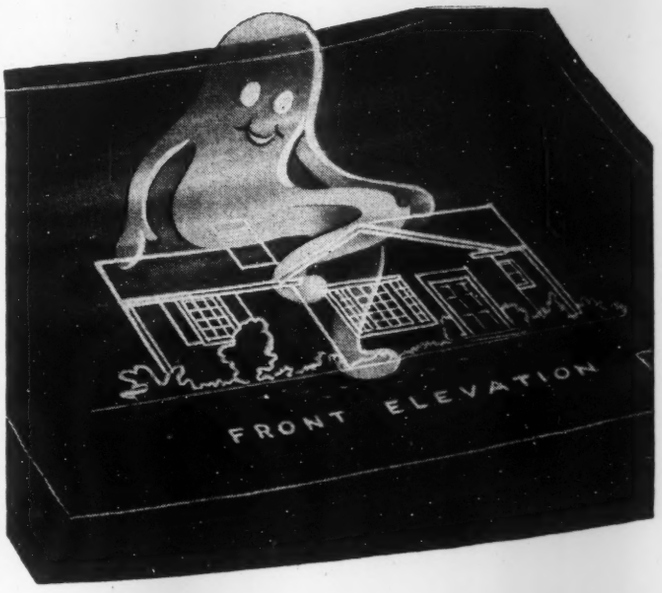
FLEXO SUPPLY COMPANY, Inc.
4226 Olive St. St. Louis (8), Mo.
In Canada: S. A. ARMSTRONG, Ltd., 115 DuPont Str., Toronto 5, Ont.

Direct acting diaphragm type pressure reducing valves developed for use as component parts of equipment where space is a determining factor.

Bulletin No. 199 gives more details. ..... It's free on request.

Manufacturing SPECIALISTS OF
CASH-ACME
Automatic PRESSURE CONTROL VALVES

A.W. CASH VALVE MFG. CORP.
6614 EAST WABASH AVE.
DECATUR ILLINOIS



The Ghost In Rev. 4

● And it was such a beautiful tracing when it first left the board – but look at the prints now, after that last revision . . . a nice big "ghost" firmly astride the front elevation. Moral . . . don't use inferior tracing cloth.

If this tracing had been on Arkwright, Rev. 4 would have produced prints just as sharp as the day a tracer first initialed it . . . because Arkwright's special mechanical process *prevents* "ghosts". This oil, wax and soap-free method of manufacture builds the translucency *all the way* through. Arkwright cloths *can't* discolor, grow brittle with age.

See for yourself how much better Arkwright is. Send for free working samples. Arkwright is sold by leading drawing material dealers everywhere. Arkwright Finishing Company, Providence, R. I.

All Arkwright Tracing Cloths have these 6 important advantages

1 *Erasures re-ink without "feathering"*
2 *Prints are always sharp and clean*
3 *Tracings never discolor or become brittle*
4 *No surface oils, soaps or waxes to dry out*
5 *No pinholes or thick threads*
6 *Mechanical processing creates permanent transparency*

Arkwright
TRACING CLOTHS
AMERICA'S STANDARD FOR OVER 25 YEARS

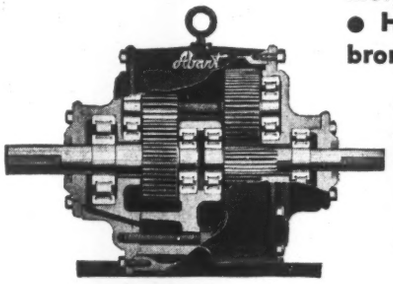
These are the TOUGH MATERIALS that go into

Abart SPEED REDUCERS

More than 75 types and sizes of ABART Speed Reducers assure A-1 service on every speed reduction job from 1/50 to 417 H.P. Spur, worm and combination. Compact, enclosed, dust-proof and oil-tight.

ABART ENGINEERS —AT YOUR CALL

Let us know your speed reduction problems. We will be glad to serve you.



- **Heat-treated nickel chromium steel**
- **Low carbon nickel molybdenum steel**
- **High grade gear bronze**

Write today for illustrated catalog with money and time saving data-

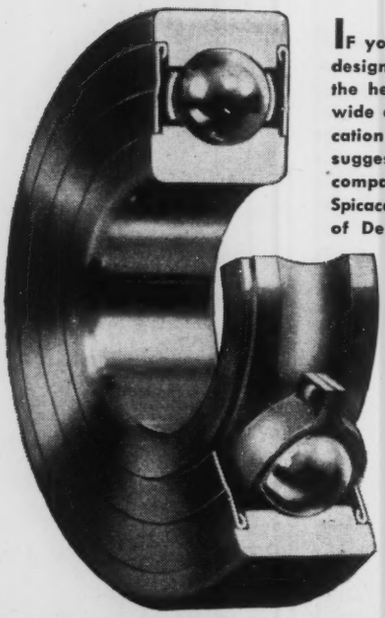
Abart
4821 W. 16th St.
Chicago 50, Ill

Something to sell

IF you are one of the forward looking manufacturers who are planning NOW for 1948 when improved design will be a necessary part of your selling in a more competitive market, then we have something to sell you.

It's ball bearing know-how—brains and experience to work with you on the design of your machinery to make the best practical use of anti-friction ball bearings.

Because we are small enough to want to grow and big enough to offer complete facilities and ample future capacity, we are good people to talk to NOW, work with on present plans, tie-up with when you must meet competition with sleeves-rolled-up in the future.



IF you have any long range design planning which requires the help of an engineer with wide experience in the application of ball bearings, we suggest that you write to this company, Attention Mr. A. R. Spicacci, Chief Engineer in charge of Design and Development.

BEARINGS COMPANY OF AMERICA • LANCASTER, PA.

BCA RADIAL • ANGULAR CONTACT • THRUST BALL BEARINGS

ENGINEERS
AVAILABLE OR WANTED

WANTED: Machine design engineer to take charge of a group of engineers and draftsmen engaged in the design of original types of complex printing equipment and related equipment in a large manufacturing plant. Shall have had several years of experience in the graphic arts and shall have successfully designed printing equipment or automatic and semi-automatic equipment of a comparable nature. Must have creative ability. Shall have academic training sufficient to enable the calculation of all necessary data essential for the design of special mechanical equipment. Starting salary $7000.00. Five-day week, liberal vacation and sick leave, retirement benefits, permanent employment. Write to Box No. 532, MACHINE DESIGN, Penton Bldg., Cleveland 13, Ohio, giving complete description of qualifications, experience, and places of employment during last ten years. Replies will be kept confidential.

♦

WANTED: Design engineer for gas-fired unit heater. Will only consider applicant having experience and ability to produce results. Write full details to Box 536, MACHINE DESIGN, Penton Bldg., Cleveland 13, Ohio.

♦

WANTED: Experienced design engineer to design precision machines and equipment for rebuilding internal combustion engines, principally automotive. Excellent opportunity promising permanency and advancement offered by progressive, old-line company in middlewest. Write today giving complete personnel history, enclosing recent photograph or snapshot. All information confidential. Address Box 531, MACHINE DESIGN, Penton Bldg., Cleveland 13, Ohio.

♦

WANTED: Mechanical designer. A mechanical designer having had layout experience on small electro mechanical apparatus. Engineering degree desirable but secondary to ability to originate and work out mechanical devices. In answer, include educational and experience details and salary requirements. Address Box 535, MACHINE DESIGN, Penton Bldg., Cleveland 13, Ohio.

♦

WANTED: Mechanical engineer. Qualified to design centrifugal and ejector pumps, preferably with practical field and factory experience. Small mid-western community. Ideal living and working conditions. Salary open. Give education, experience and age. Address Box 530, MACHINE DESIGN, Penton Bldg., Cleveland 13, Ohio.

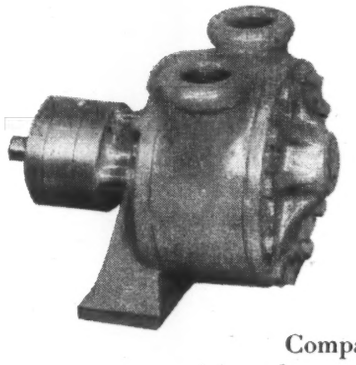
♦

WANTED: Mechanical engineer. Graduate mechanical engineer having five years experience on original design electro mechanical small apparatus or instruments. Supervising experience secondary to ability to work out original designs. In answer, include educational and experience details and salary requirements. Address Box 534, MACHINE DESIGN, Penton Bldg., Cleveland 13, Ohio.

♦

WANTED: Mechanical engineer to develop and design paper converting and packaging machinery. Experience in designing essential. Age 30-40. Salary open. Write Procurement Manager, Marathon Corporation, Menasha, Wisconsin.

TUTHILL MODEL CK PUMPS...



A Compact Answer to Your High Pressure Needs

Compact is the word for this internal-gear rotary pump by Tuthill. Model CK is designed to save space, materials and money in high pressure service on machine tools, engines and hydraulic mechanisms. Capacities up to 50 g.p.m. and pressures up to 400 p.s.i. Direct motor drive, V-belt units and integral drives. Write for Model CK bulletin.

TUTHILL PUMP COMPANY
939 East 95th Street • Chicago 19, Illinois

SIMPLE and EFFICIENT
DIRECT DRIVE COUPLINGS

This exclusive direct drive coupling, with rubberized cushion gripped permanently by die-cast ends, has no parts to get out of order, or to lubricate. Minimizes misalignment, free end float, and backlash. Custom-made for specific job. Lengths from 2-1/2" up. Bores 5/16", 3/8", 7/16" and 1/2". A million giving satisfactory service.

Write for sample and further details.

GUARDIAN PRODUCTS CORP.
212 E. MICHIGAN STREET MICHIGAN CITY, INDIANA

KUX

EXPERTS AT
CAM
CUTTING and GRINDING

The largest, most completely equipped plant in the country devoted to CAM cutting and grinding is at your service. 25 YEARS of experience in making special cams for thousands of companies has made us experts at cam cutting and grinding. Our facilities and equipment, finest in the country, permit us to manufacture any style or size Cam, Geneva Motion or Scroll Plate in quantities of 1, 10 or 10,000. Accuracy can be maintained to split thousandths, and surfaces to micro-finishes. Send us specifications or blueprints and we will be glad to submit a detailed quotation on your requirements.

KUX MACHINE COMPANY
3928 WEST HARRISON STREET • CHICAGO 24, ILLINOIS

ADVERTISING INDEX

A

Abart Gear & Machine Co. 313
Accurate Spring Manufacturing Co. 199
Acme Industrial Co. 300, 303
Aeroquip Corp. 167
Aircraft Screw Products Co., Inc. 260
Alemite Division Stewart Warner Corp. . 171
Alexander Brothers 222
Allegheny Ludlum Steel Corp. 301
Allen-Bradley Co. 33, 34
Allen Manufacturing Co., The 188
Alliance Manufacturing Co. 74
Allis-Chalmers Manufacturing Co. 19, 47
Aluminum Company of America 68
American Brass Co., The 197, 198
American Chain & Cable, Automotive & Aircraft Division 293
American Machine & Metals, Inc., United States Gauge 25
American Magnesium Corp., Subsidiary of Aluminum Co. of America 36
American Manganese Bronze Co. 309
American Metal Hose, Branch The American Brass Co. 183
American Screw Co. 216
Ampco Metal, Inc. 242
Anti-Corrosive Metal Products Co., Inc. .. 264
Arens Controls, Inc. 309
Arkwright Finishing Co. 313
Armstrong Cork Co. 95
Arrow-Hart & Hegeman Electric Co., The . 55
Asbestos Textile & Packing Division Raybestos-Manhattan, Inc. 228
Atlantic Plastics, Inc. 281
Austenal Laboratories, Inc. 17
Automotive & Aircraft Division, American Chain & Cable 293

B

Baldor Electric Co. 223
Barco Manufacturing Co. 212
Barnes-Gibson-Raymond 300
Barnes, Wallace, Co. 28
Barth Stamping & Machine Works, Inc. .. 97
Bearings Company of America 314
Bear Manufacturing Co. 306
Bethlehem Steel Co. 52
Billings & Spencer Co., The 299
Blackmer Pump Co. 218
Bliss & Laughlin, Inc. 291
Bohn Aluminum & Brass Corp. 277
Brandt, Charles T., Inc. 4
Bristol Company, The 192
Bridgeport Thermostat Co., Inc. 215
Brown-Brockmeyer Co., The 39
Brown & Sharpe Manufacturing Co. 285
Bruning, Charles, Co., Inc. 73
Buffalo Weaving and Belting Co. 310
Bundy Tubing Co. 42

C

Cambridge Wire Cloth Co. 184
Carpenter Steel Co., The 44, 45, 248
Cash, A. W., Valve Manufacturing Corp. 313
Chain Belt Company of Milwaukee 56, 57
Chicago Metal Hose Corp. 22
Chicago Rawhide Manufacturing Co. .. 2, 217
Chicago Screw Co., The 282
Cincinnati Gear Co., The 308
Cleveland Worm & Gear Co., The 241
Clifford Manufacturing Co. 267
Climax Molybdenum Co. 179
Clinton Sales Co. 285
Cold Metal Products Co., The 263
Crane Co. 12
Curtis Universal Joint Co., Inc. 190
Cutler-Hammer, Inc. ..... Inside Front Cover

D

Dayton Rubber Manufacturing Co., The .. 32
De Laval Steam Turbine Co. 236, 307
Denison Engineering Co., The 245
Detroit Bevel Gear Co. 304
Dodge Manufacturing Corp. 258
Dow Chemical Co. 14, 15
Dow Corning Corp. 26
Drake Manufacturing Co. 311
du Pont de Nemours, E. I., & Co., Inc. . 49, 231
Durant Manufacturing Co. 302

E

Eastman Kodak Co. 185
Eaton Manufacturing Co., Reliance Division 30
Eberhardt-Denver Co. 303
Electric Wheel Co. 291
Electrol, Inc. 250
Electro Metallurgical Co. 20
Elliott, B. K., Co. 302
Elliott Manufacturing Co. 312
Emerson Electric Manufacturing Co., The . 96
Euclid Electric & Mfg. Co., The 304
Ex-Cell-O Corp. 275

F

Fafnir Bearing Co., The 297
Fairfield Manufacturing Co. 186
Falk Corp., The 86, 87
Federal Bearings Co., Inc., The 200
Federal-Mogul Corp. 256
Fellows Gear Shaper Co., The 189
Felt Products Manufacturing Co. 307
Flexible Steel Lacing Co. 290
Flexo Supply Co., Inc. 312
Foote Bros. Gear & Machine Corp. 23
Formica Insulation Co., The 273
Formsprag Co. 278
French & Hecht, Inc. 302

G

Galland-Henning Manufacturing Co. 296
Gatke Corp. 261
Gear Specialties 29
General Electric Co. 31, 59, 82, 83, 243, 276
Gerotor May Corp. 54
Gilmer, L. H., Co. 195
Gisholt Machine Co. 43
Gits Bros. Mfg. Co. 27
Gleason Works 5
Globe Steel Tubes Co. 208
Goodrich, B. F., Co., The 280
Goodrich, B. F., Chemical Co. (Hycar) .. 81
Greer Hydraulics, Inc. 196
Guardian Electric Manufacturing Co. ... 289
Guardian Products Corp. 315

H

Hanna Engineering Works 88
Hannifin Manufacturing Co. 235
Hansen Manufacturing Co., The 252
Hanson-Van Winkle-Munning Co. 244
Harper, H. M., Co., The 218
Haydon Manufacturing Co., Inc. 295
Heim Company, The 230
Holo-Krome Screw Corp., The 232
Houghton, E. F., & Co. 169
Howell Electric Motors, Inc. 225
Hunt, C. B., & Son, Inc. 269
Hunter Pressed Steel Co. 259
Hydro-Power, Inc. 41

I

Imperial Brass Manufacturing Co. 72
Imperial Pencil Tracing Cloth Co. 295
Ingersoll-Rand 304
Industrial Gear Manufacturing Co. 310
International Nickel Co., Inc., The 53

J

Jack & Heintz Precision Industries, Inc. .. 85
James, D. O., Manufacturing Co. 100
Janette Manufacturing Co. 295
Johnson Bronze Co. 165
Johnson, Carlyle, Machine Co., The 63

IF YOU USE OR CONSIDER USING

MAGNESIUM

(ALUMINUM OR BRONZE)

SAND CASTINGS

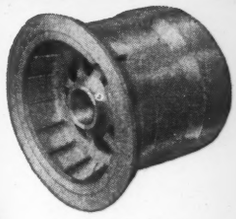
There are advantages in going to

WELLMAN

Here are several important advantages our customers have gained by turning to Wellman for Magnesium Sand Castings:

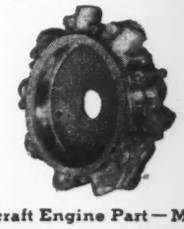
1. Saving of time from blueprints to production because of our 36 years' experience in patterns and 15 years' experience in magnesium castings.
2. Complete laboratory control of all steps in the production of castings — from the raw metal through all processes to the finished casting.
3. Complete responsibility for the job from blueprints to castings . . . essential to insure a fine degree of accuracy particularly in magnesium castings.

May we quote on your castings' requirements? If you prefer not to send blueprints we shall be glad to have a field representative call.



Aircraft Wheel Magnesium

Gear Housing — Aluminum



Aircraft Engine Part — Magnesium

Aircraft Wheel Strut Part — Magnesium

Patterns In Metal or Wood

"WELLMAN means WELL-CAST"

THE WELLMAN BRONZE & ALUMINUM COMPANY

GENERAL OFFICES:

2547 EAST 93rd STREET • CLEVELAND 3, OHIO

CASTINGS X-RAY INSPECTED

ADVERTISING INDEX

Johnson Corp., The 308
Jones, Howard B., Division 294

K

Kaydon Engineering Corp., The 238
Kerr Manufacturing Co. 46
Keuffel & Esser Co. 245
Koppers Co., Inc. 255
Kux Machine Co. 315

L

Lebanon Steel Foundry 94
Lewellen Manufacturing Co. 290
Linear, Inc. 240
Lincoln Engineering Co. 251
Link-Belt Co. 11
Lord Manufacturing Co. 61
Lovejoy Flexible Coupling Co. 284

Mc

McCullough Motors Corp. 13
McGill Manufacturing Co., Inc. 40

M

Madison-Kipp Corp. 75
Makepeace, D. E., Co. 16
Mall Tool Co. 298
Manheim Manufacturing & Belting Co. .. 84
Master Electric Co., The ..... 35, Inside Back Cover
Mechanics Universal Joint Division, Borg-Warner Corp. 194
Meyercord Co., The 187
Mica Insulator Co. 247
Michigan Tool Co. 233
Milsco Manufacturing Co. 303
Morganite, Inc. 279
Morse Chain Co. 249

N

National Bearing Division, American Brake Shoe Co. 286
National Broach & Machine Co. 224
National Formetal Co., Inc. 79
National Lock Washer Co., The 282, 294
National Motor Bearing Co., Inc. ... 206, 207
National Screw & Manufacturing Co., The 191
Nelson Sales Corporation 239
New Departure Division of General Motors Corp. 6
New Jersey Zinc Co., The 173
Nice Ball Bearing Co. 254

O

Ohio Gear Co., The 48
Ohio Rubber Co., The 37
Ohio Seamless Tube Co., The 201
Oilgear Co., The 9
Orange Roller Bearing Co., Inc. 65
Owens-Corning Fiberglas Corp. 209

P

Parker-Kalon Corp. 8
Peerless Electric Co., The 309
Pesco Products Division, Borg-Warner Corp. 283
Philadelphia Gear Works, Inc. 38
Phillips Screw Manufacturers 320
Progressive Welder Co. 319
Propulsion Engine Corp. 290
Pure Carbon Co., Inc. 311

R

Racine Tool & Machine Co 221
Rapids-Standard Co., Inc., The 307
Raybestos-Manhattan, Inc., Asbestos Textile & Packing Division 228
Reeves Pulley Co. 50, 51
Reliable Spring & Wire Forms Co., The .. 308
Reliance Division Eaton Manufacturing Co. 30
Revere Copper & Brass, Inc. 253
Reynolds Metals Co. 204, 205
Rivett Lathe & Grinder, Inc. 80
Robbins & Myers, Inc. 21
Rockford Clutch Division Borg-Warner Corp. 299
Roller Bearing Company of America ... 262
Roper, Geo. D., Corp. 229
Ross Heater & Mfg. Co., Inc. 90
Russell, Burdsall & Ward Bolt & Nut Co. 214
Ruthman Machinery Co., The 311

S

Schatz Manufacturing Co., The 181
Schrader's, A., Son 234
Scovill Manufacturing Co. 219
Shakeproof, Inc. 257
Shenango-Penn Mold Co. 89
Sillcocks-Miller Co., The 312
SKF Industries, Inc. 226
Smith-Armstrong Forge, Inc. 296
Smith, F. A., Manufacturing Co., Inc. ... 177
Smith, Winfield H., Corp. 284
Sperry Products, Inc. 306
Square D Co. 92, 93
Standard Pressed Steel Co. 18, 306
Standard Tube Co., The 237
Steel Founders' Society 266
Stewart, F. W., Manufacturing Corp. ... 294
Strom Steel Ball Co. 284
Sundstrand Machine Tool Co. 10
Superdraulic Corp. 91
Superior Carbon Products, Inc. 292
Superior Steel Corp. 67

T

Telechron, Inc. 78
Thompson-Bremer & Co. 1
Timken Roller Bearing Co., The ..... 60, Back Cover
Tinnerman Products, Inc. 293
Tomkins-Johnson Co., The 220
Torrington Co., The 213
Trent Tube Mfg. Co. 58
Trico Fuse Manufacturing Co. 299
Tube Reducing Corp. 210, 211
Tuthill Pump Co. 315
Twin Disc Clutch Co. 268

U

Union Carbide & Carbon Corp. 20
United Electric Controls Co. 296
United Screw & Bolt Corp. 175
United States Graphite Co., The . 76, 77, 305
United States Gauge Division of American Machine & Metals, Inc. 25
U. S. Automatic Corp. 292
U. S. Hoffman Machinery Corp. 62

V

Valley Electric Corp. 300
Valvair Corp. 291
Veeder-Root, Inc. 227
Vickers, Inc. 99
Viking Pump Co. 298

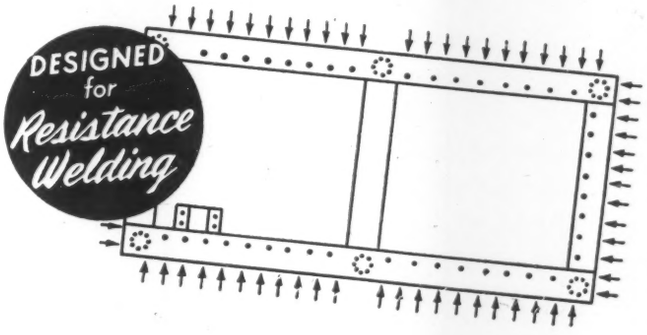
W

Wagner Rustproofing Co. 278
Waldes-Kohinoor, Inc. 265
War Assets Administration 274
Ward Leonard Electric Co. 24
Weatherhead Co., The 69
Wellman Bronze & Aluminum Co. 317
Western Felt Works 280
Westinghouse Electric Corp. . 70, 71, 202, 203
Whitney Chain & Mfg. Co., The 272
Wickwire Spencer Steel Division The Colorado Fuel & Iron Corp. 64
Wisconsin Motor Corp. 292
Wisconsin Pharmacal Co. 293
Witte Engine Works 298
Wolverine Tube Division Calumet & Hecla Consolidated Copper Co. 66
Worthington Pump and Machinery Corp. 193

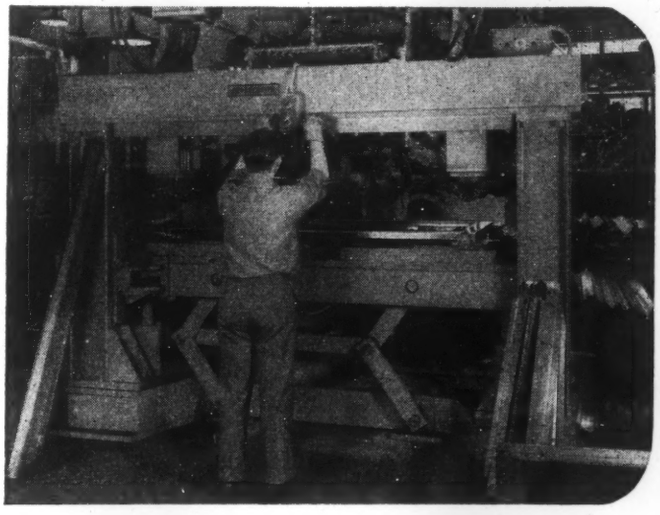
Engineers Available or Wanted 314

How spot-welding changed

A BOTTLE-NECK INTO A LINE-PACER



It takes 250 welds to make a Fruehauf door frame. 168 of these welds are made on 3 Progressive machines—16 seconds to a machine, welding time. One of the three is shown below.



Doors used to be the chief bottle-neck in the production of Fruehauf truck-trailers.

Recently Fruehauf design engineers and Progressive Welder process engineers got together. They re-designed the doors for automatic spot-welding. Three Progressive special Ultra-Speed universal welding machines were designed and installed. These not only take care of normal requirements but actually provide 100% reserve capacity for trailer door production.

RH, LH and side door frames (with 250 spot welds each) of several different sizes are assembled on the 3 machines at a rate of 60 complete assemblies per hour. Latch mounting plates and stiffeners are added, using 12 portable Progressive welding guns, with the door in a turntable fixture.

In addition to simpler manufacture and increased productivity per machine-hour and man-hour, Fruehauf also saves floor space and has a better, stronger, door —that weighs 23% less. To the trailer operator that means increased payload.

This is another of the many case histories of "It Pays to Weld Progressive." We will be glad to assist you, too, in "designing for welding"—to lower your costs, increase production and improve your product.

For the latest news on Resistance Welding designs and methods, read the monthly Progressive WELDING PICTORIAL. Ask for it on your company letterhead.

IT PAYS TO WELD

PROGRESSIVE Welder Co. 3050 E. OUTER DRIVE • DETROIT 12

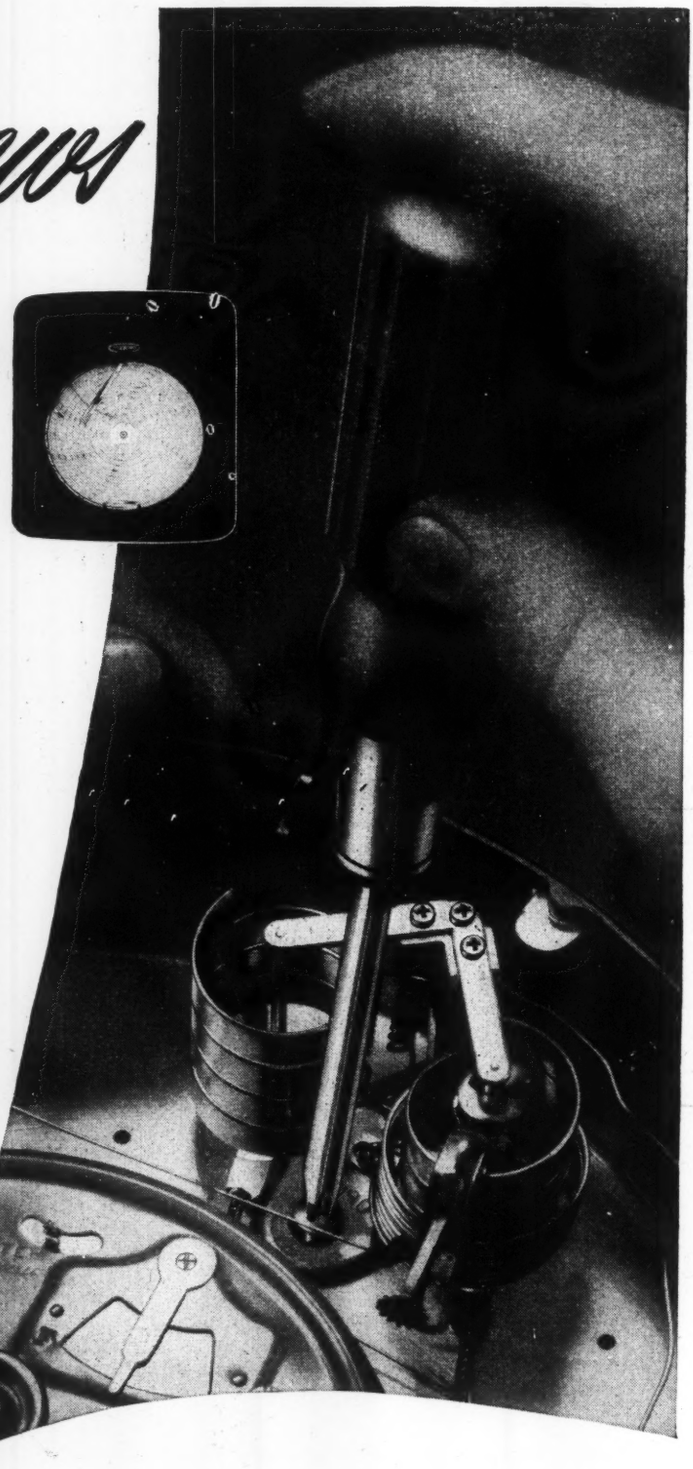
RESISTANCE WELDING EQUIPMENT

CABLE ADDRESS "PROGWELD"

MEMBER RESISTANCE WELDER MANUFACTURERS ASSOCIATION RWMA

Phillips Screws

GIVE POSITIVE "FIX" ON CRITICAL ASSEMBLY FOR FOXBORO



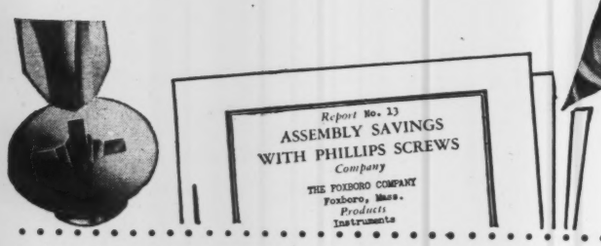
High spots from independent investigator's on-the-scene report . . . another study of assembly methods in key industrial plants by James O. Peck Company.

● "We gave Phillips Screws a big responsibility," Foxboro's chief engineer explained, "to maintain an accurate alignment of the helical coils in our temperature recording and control instruments.

"PHILLIPS' POSITIVE DRIVE makes positive fastening easier, more certain. Five Phillips Head Screws hold in accurate position the helical coils which are the heart of these instruments. The four-point contact of the driver in the Phillips recess makes it easy for the assembler to start the screws and drive them home. And we can depend on them to hold securely despite vibration or shock.

"WE SAVE DRIVER SLIPS that would cost us up to $50 apiece. This is a tight-spot assembly where the slip of a driver – a constant hazard when driving slotted head screws – would irreparably damage the delicate capillary tubes, less than a half-inch away. The cost of such a slip – disassembly, replacing the damaged element, and reassembly – runs up to fifty dollars."

GET THE WHOLE INSIDE STORY of this critical assembly and other equally interesting studies . . . of metal, wood and plastic products. Plenty of tips to help you improve your own assemblies. FREE–use the coupon.



Phillips Screw Mfrs., c/o Horton-Noyes MD-14
2300 Industrial Trust Bldg., Providence, R. I.

Send me reports on Assembly Savings with Phillips Screws.

Name .....

Company .....

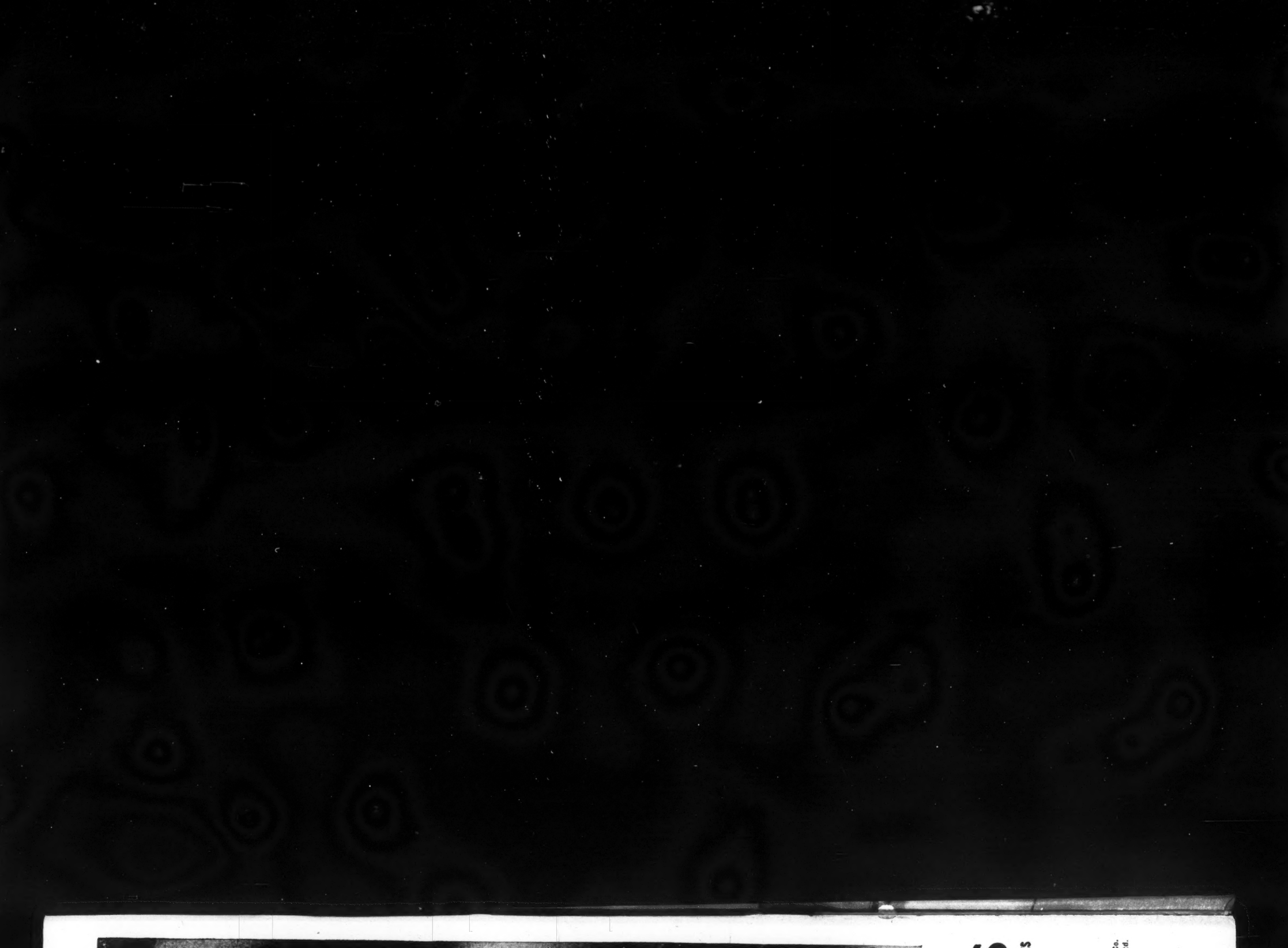
Address .....

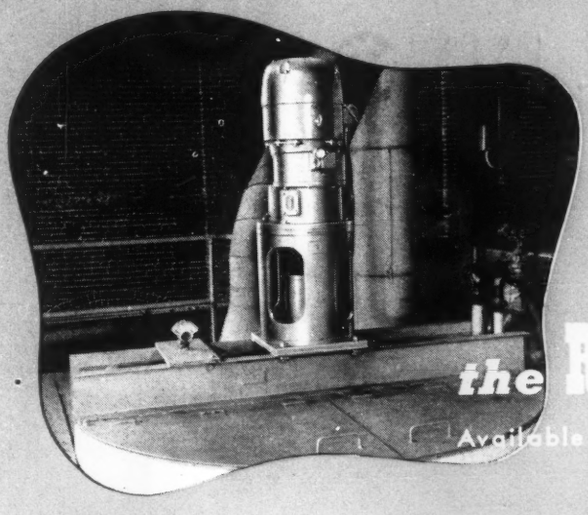
PHILLIPS *Recessed Head* SCREWS

Wood Screws • Machine Screws • Self-tapping Screws • Stove Bolts

24 SOURCES

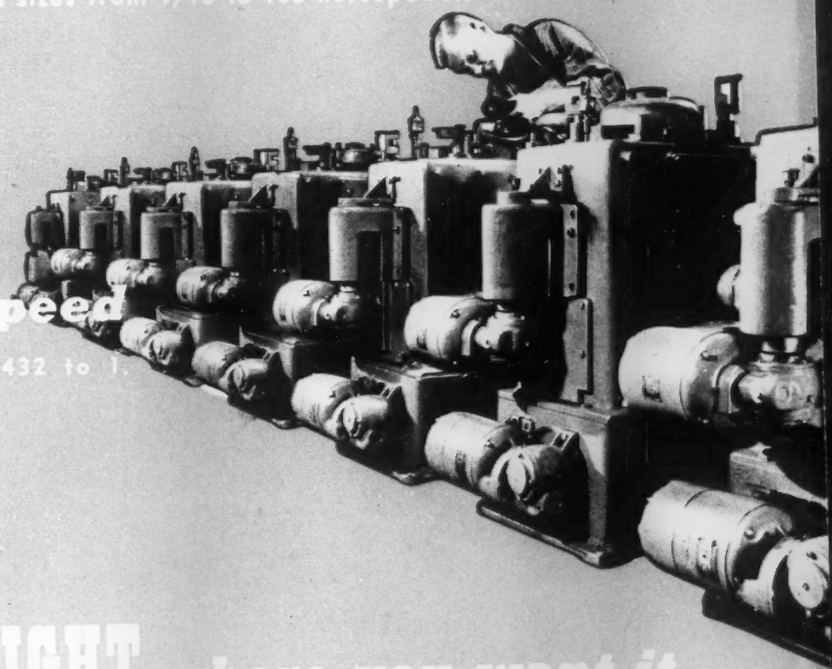
American Screw Co.
Central Screw Co.
Chandler Products Corp.
Continental Screw Co.
Corbin Screw Div. of American Hdwe. Corp.
The H. M. Harper Co.
International Screw Co.
Lamson & Sessions Co.
Milford Rivet and Machine Co.
National Lock Co.
National Screw & Mfg. Co.
New England Screw Co.
Parker-Kalon Corporation
Pawtucket Screw Co.
Pheoll Manufacturing Co.
Reading Screw Co.
Russell Burdsall & Ward Bolt & Nut Co.
Scovill Manufacturing Co.
Shakeproof Inc.
The Southington Hardware Mfg. Co.
The Steel Company of Canada, Ltd.
Sterling Bolt Co.
Stronghold Screw Products, Inc.
Wolverine Bolt Company





the RIGHT horsepower

Available in sizes from 1/10 to 100 horsepower.

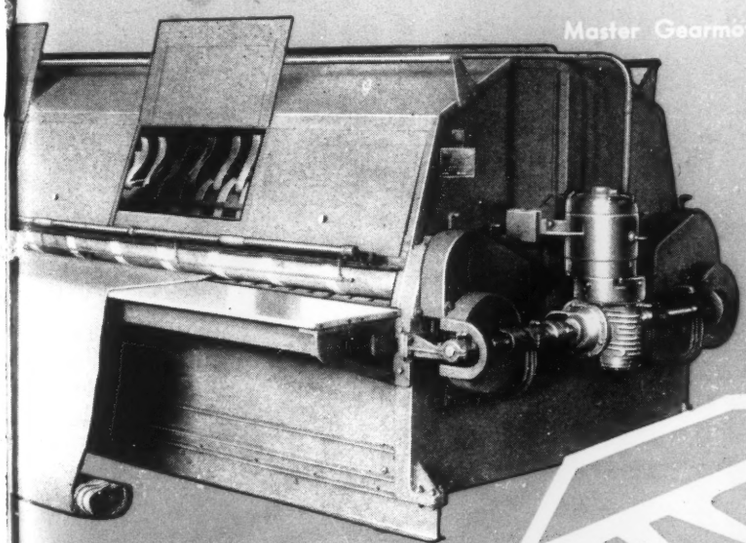


the RIGHT shaft speed

Gear reduction ratios range up to 432 to 1.

and RIGHT where you want it

Master Gearmotors, available in millions on millions of combinations of types and ratings, permit you to use a power drive on each job that's just right . . . a power drive that will add greatly to the compactness, appearance, and economy of each of your applications. Use Master Gearmotors to increase the salability of your motor-driven products . . . improve the economy, safety, and productivity of your plant equipment.



MASTER

GEARMOTORS

THE MASTER ELECTRIC COMPANY • DAYTON 1, OHIO

NEW CINCINNATI DIE SINKER USES 32 TIMKEN BEARINGS

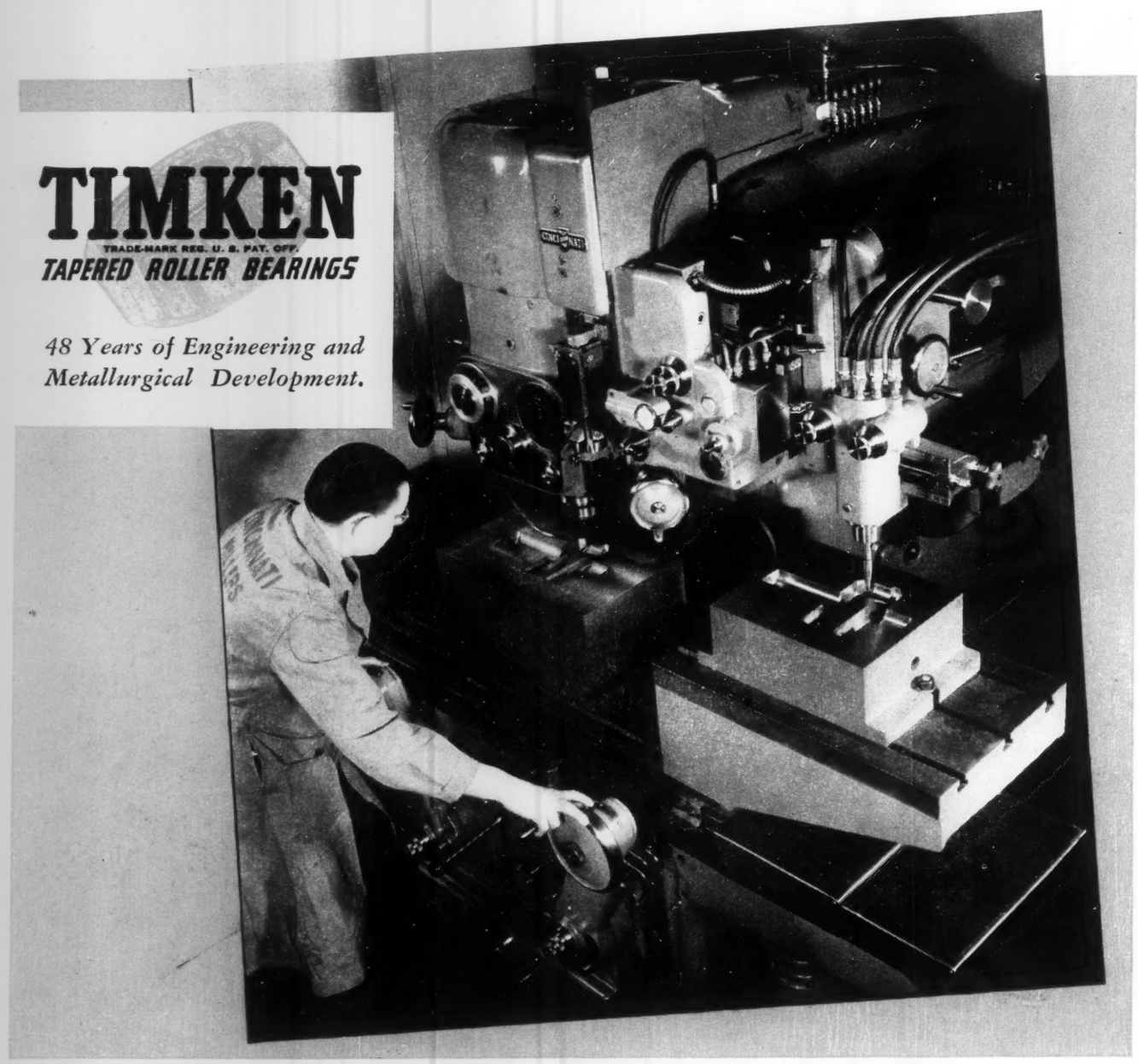
Typical of the spectacular post-war progress being made in modern machine tool development is the new Cincinnati 16" Vertical Hydro-Tel Die Sinker which has introduced some valuable production pluses into this important operation.

As shown in the photograph, the machine is duplicating a single-throw crankshaft die (left) from a master pattern (right), scanning the pattern automatically and thus relieving the operator of considerable work and responsibility during the progress of the cut.

Additional advantages stressed by the manufacturer are: saving of time in roughing out die impression because of the heavy cuts that can be taken; saving of time in hand finishing due to the accuracy of the machine-cut die impression.

The Cincinnati Milling Machine Company for many years has made liberal use of Timken Tapered Roller Bearings as an important aid to precision, endurance and economy. In this case 32 Timken Bearings are used to eliminate friction, reduce wear, carry radial, thrust and combined loads and hold moving parts in correct and constant alignment.

Look for the trade-mark "TIMKEN" on every tapered roller bearing you use. The Timken Roller Bearing Company, Canton 6, Ohio.

TIMKEN
TRADE-MARK REG. U. S. PAT. OFF.
TAPERED ROLLER BEARINGS

48 Years of Engineering and Metallurgical Development.